

# FLORA MALESIANA

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SERIES I - SPERMATOPHYTA.

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## OLACACEAE (H. Sleumer, Leyden)

Trees or erect, rarely scandent shrubs, sometimes hemi-, rarely autoparasitic. *Leaves* spirally arranged, rarely distichous, simple, entire, often with parchment-like and/or finely tuberculate surfaces, mostly penni-, rarely pli-nerved, petioled, exstipulate, not rarely of a greyish-yellowish-olivaceous colour and dull, especially in the dry state. *Inflorescences* axillary, rarely on old wood, short racemes and panicles, or elongate spikes, often fascicles or glomerules, these rarely reduced to a solitary flower. *Flowers* generally bisexual, rarely unisexual (monoecious or andro-dioecious), generally actinomorphic, cyclic, 3–7-merous, rarely heterostylous. *Calyx* small in anthesis, often very shortly 3–7-lobed, -dentate, or -crenulate, the cup-like base free or adnate to the disk and/or ovary to various degrees, afterwards sometimes accrescent, and then either free from or connate with the fruit. *Petals* 3–7, free or connate below, valvate, caducous. *Disk* sometimes present, consisting of free glands, or cup-like, rarely accrescent and then covering the fruit almost to the apex. *Stamens* 1–3-seriate, hypogynous, 4–15 in number, epipetalous, or partly also episepalous, rarely in part staminodial; anthers basi- or medifixed, with 2 thecae, or rarely with 1 theca, dehiscing lengthwise. *Ovary* mostly superior, rarely semi-inferior when immersed in the disk, or inferior when connate with the cup-like flower-axis (*Schoepfia*), either 1-locular with 2–3 (–5; –7) ovules pendent from the apex of a central free placenta (sometimes projecting into the stylar canal), or 3–5 (–7)-locular in the lower part only (rarely completely so), a single ovule hanging then from the inner angle into each of the cells; ovules generally anatropous, uni-, bi-, or ategmic; style, if any, conical, columnar or filiform, with a small, sometimes 3–5-partite or -lobed, subsessile stigma. *Fruit* a drupe with a thin and often fleshy, sometimes dehiscent or caducous exocarp, and a crustaceous to woody endocarp, or concrescent with the cup-shaped floral axis, or with an accrescent calyx or disk which then forms an external fleshy layer. *Seed* 1; testa (if any) thin; endosperm abundant, starchy and/or oily, bearing the embryo at its apex; cotyledons 2, 3, or 4.

**Distribution.** A pantropical family with about 27 genera and approximately 170 *spp.*, predominantly in the tropics, a few in the subtropics.

In Malesia 9 genera with a total of 14 *spp.* Of these only *Ochanostachys* is strictly limited to Malesia. *Erythralium*, *Harmandia* and *Scorodocarpus* are Indo-Malesian. Some have a wider Old World range, viz. *Anacolosia* (1 *sp.* in Central Africa, 2 *spp.* in Madagascar and 3 *spp.* in the Pacific), *Olax* (also in Africa, Australia, and the Pacific), and *Strombosia* (also in Africa). *Schoepfia* is Indo-Malesian, with c. 20 *spp.* also in tropical America. *Ximenia* is pantropical. The genus *Malania* (limited to SW. China) is closely related to *Scorodocarpus*.

The Malesian representatives thus show a distinct alliance with those of SE. Asia, and a less marked one with Australia and the Pacific (*Anacolosia*, *Olax*, *Ximenia*). Alliances are strong with Africa in the genera *Anacolosia*, *Olax*, and *Strombosia*.

**Ecology.** Most Malesian *Olacaceae* occur in primary and secondary lowland (also littoral) rain-forest. *Olax* and *Ximenia* are found mainly in drier vegetation types as teak forest, brushwood or beach vegetation. *Ximenia* sheds its leaves in the dry season.

The size of Malesian *Olacaceae* is mostly moderate to small, and the majority belongs to the forest substage; they never become dominant

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**Parasitism.** Several *Olacaceae* are known for their non host-specific parasitism, as is a common feature in *Santalaceae* and *Loranthaceae*. Root haustoria have been found in *Olex* and *Ximenia* in Asia, and also in *Ptychopetalum* and *Schoepfia*, both in America. The extent to which this parasitism occurs in these and possibly in other genera is not known. For Malesia proper no data on parasitism have been published but it can be expected for *Olex scandens*, *Ximenia americana*, and maybe for *Schoepfia fragrans*. Cf. BARBER, Studies in root-parasitism. The haustoria of *Olex scandens*. Mem. Dept. Agr. India, Bot. ser. 2 (4) (1907) 1–47; KUIJT, The biology of parasitic flowering plants (1969) 65.

**Dispersal.** Little is known of the seed dispersal of *Olacaceae*; their fruits with fleshy pericarp and a big seed point to a possible dispersal by animals, mainly monkeys and birds eating the fruits. Fruits of the coastal *Ximenia* are able to float for some time in seawater (RIDLEY, Disp., 1930, 195, 265, 346).

**Morphology.** The family has an interesting morphology in that, though small in size, it exhibits *pro ratio* a great pluriformity in important features as compared with many other families. The habit may be erect or scandent, plants may be armed with spines or thorns (*Ximenia*, *Olex*) or unarmed; in *Erythralum* axillary tendrils occur (fig. 8), even rarely bifid. Of several genera it has been proved that they are hemiparasitic.

Also in the flowers variability occurs in merousness, and stamens, which are usually epipetalous, may also occur partly episepalous, rarely in part staminodial; stamens may be up to 3-seriate.

The ovary is superior, but may become through various ways of concrescence with disk and/or receptacle inferior or lead to an inferior fruit.

In *Erythralum* flowers are bisexual or andro-dioecious, in *Ximenia* flowers are bisexual or rarely functionally unisexual, in *Olex scandens* and *Schoepfia* flowers are often heterostylous, in *Harmandia* flowers are monoecious, in many others they are normally bisexual.

The ovary is either one-celled with a central placenta or the lower part is more-celled with ovules pendent in these cells. Ovules may be bitegmic, unitegmic or even ategmic.

Phytochemically there is also variability: in *Ochanostachys* and *Harmandia* tissues contain cells with milky juice, *Scorodocarpus* reeks of garlic, while *Erythralum* has also a bad smell.

Leaf and wood anatomy and pollen morphology are also very diverse; see below.

This pluriformity is striking, because the family must be of ancient date, as can be derived from the fact that it does not only range over the tropics of all continents but even three genera are trans-Atlantic and one trans-Pacific.

**Galls.** Cf. DOCTERS VAN LEEUWEN, Zoocecid. Neth. Ind. (1926) 175 (galls of *Anacolosa frutescens*).

**Embryology.** Cf. AGARWAL, Phytomorphology 11 (1961) 269–272 (*Strombosia*); *ibid.* 13 (1963) 185–196 (*Olex*).

**Phytochemistry.** There is a more or less general tendency in *Olacaceae* to deposit oxalate of lime in various parts, and silicic acid in leaves (not in wood). Seeds tend to be rich in oil. Triglycerides with C-18 acetylenic acids such as santalbic (ximenynic), isanic and isanolic acid occur amply in seed oils (e.g. *Ximenia americana*), but are also present in roots, stems and leaves (*Ximenia americana*, *Olex stricta*), linking *Olacaceae* biochemically with *Santalaceae* and *Opiliaceae*.

The lack of knowledge about polyphenolic compounds in *Olacaceae* is astonishing. Tannins, probably of mixed origin (mainly flavonoid type, but sometimes accompanied by galloyl tannins) are abundantly present in the bark, roots or leaves of *Ximenia americana*, *Anacolosa* spp., *Olex* spp., and others.

Prunasin-like (i.e. yielding HCN and benzaldehyde) cyanogenic glycosides are present in different parts of *Ximenia* spp. and *Olex* spp. Saponins seem to occur rather widely in *Olacaceae*. Olacaceous sapogenins appear to be mainly triterpenoids; this character is shared with, among others, *Opiliaceae* and *Santalaceae*.

Alcaloids are possibly present in some species of the palaeotropic genera *Anacolosa*, *Olex*, and *Strombosia*.



*Literature.* R. HEGNAUER, Chemotaxonomie der Pflanzen 5 (1969) 227; in Sleumer, *Olacaceae*, Flora Neotropica, in press. — R. HEGNAUER.

*Vegetative anatomy.* For general accounts see SOLEREDER (1899, 1908), METCALFE & CHALK (1950), REED (1955) and BAAS *et al.* (1982, with full references to older literature). Leaf and wood anatomy of the *Olacaceae* are very diverse, but still support the concept of a natural family. Stomatal type, secretory cavities, laticifers, silicified cells, nodal, petiole and midrib vasculature, idioblastic sclereids, type of vessel perforations, parenchyma distribution, ray type, and fibre pitting all show distinct character states enabling a reconstruction of phylogenetic trends and relationship patterns within the family (see BAAS *et al.*, 1982; REED, 1955). Most Malesian genera have their closest relatives in Africa and/or the New World. *Ochanostachys* is anatomically more or less identical to *Coula* (Africa) and *Minquartia* (South America) and has both secretory cavities and laticifers. *Harmandia* strongly resembles *Aptandra* from Africa and South America and shares the occurrence of infrequent (reduced?) laticifers in the mesophyll. *Anacolosa* has its closest relative in the neotropical genus *Cathedra*. *Olax*, *Schoepfia*, and *Ximenia* belong to a larger, anatomically fairly homogeneous group including African and neotropical representatives. This group also shares many characters with *Anacolosa* and *Cathedra* on the one hand, and with *Santalaceae* and *Loranthaceae* on the other. *Strombosia* belongs to a well defined anatomical assemblage including *Strombosiopsis* and *Diogoia* from Africa and *Tetrastylidium* from South America. This group is unrelated to *Anacolosa*, with which it has been placed in the same tribe *Anacoloseeae* in the past. *Scorodocarpus* shows remote affinities to *Strombosia*, but is closer anatomically to the neotropical *Brachynema*. *Erythralum* remains anatomically fairly isolated within the family, but differences are insufficient to advocate a separate family. The geographical distribution of the anatomical units (largely coinciding with the traditionally recognized tribes, with the exception of the *Anacoloseeae*) is suggestive of considerable age and conservatism of the anatomical character complexes. For a key to the genera based on leaf anatomy, see BAAS *et al.* (1982). A detailed wood anatomical survey of the family is in preparation (L. VAN DEN OEVER, Blumea).

*Literature:* BAAS, VAN OOSTERHOUD & SCHOLTES, Allertonia 3 (1982) 155–210; METCALFE & CHALK, Anatomy of the Dicotyledons I, Oxford (1950); REED, Mem. Soc. Brot. 10 (1955) 29–79; SOLEREDER, Systematische Anatomie der Dicotyledonen & Ergänzungsband, Stuttgart (1899 & 1908). — P. BAAS.

*Pollen morphology. General description.* *Olacaceae* exhibit a variable pollen morphology. In *Olax* and *Ptychopetalum* both intra- and interspecific, geographically based variation occurs. In general Olacaceous pollen grains are single; size varies between 11  $\mu$ m (*Heisteria micrantha*) and 48  $\mu$ m (*Olax benthamiana*) and shape is basically subequiaxial, ranging from oblate to peroblate in *Anacolosa* and *Olax* to subprolate in *Diogoia* and *Tetrastylidium*. Mostly grains are isopolar, but subisopolar and heteropolar types occur also. This heteropolarity may be expressed in sculpturing (*Coula p.p.*, *Ochanostachys*), in apertures (*Heisteria p.p.*, *Strombosia p.p.*), or in shape and apertures (*Aptandra*, *Harmandia*, *Ongokea*, *Schoepfia*). In *Coula*, *Heisteria* and *Strombosia* both isopolar and heteropolar types occur.

According to apertures, *Olacaceae* can be divided into four main groups, A, tricolpate with an endoaperture which is not wider than the colpus or tricolporate with a rectangular or slightly elliptical endoaperture at the equator, B, 3- (4-, 5-) stephanoporate and C, 6-diploporate. In *Schoepfia* syncolpate ectoapertures are found at the proximal pole. The apertures are generally closed by a granular-verrucate membrane.

The sculpture of the tectum varies between psilate (*Erythralum*, *Minquartia*, *Schoepfia*), perforate (*Scorodocarpus*), reticulate (*Diogoia*, *Strombosiopsis*, *Ximenia p.p.*) and microechinulate (*Curupira*, *Octoknema*). The sculpture may be different between apo- and mesocolpia. *Chaunochiton* has unique sculptured ridges. Infratectal structure is mostly granular but transitions to a columellate structure are frequent. In *Anacolosa* and *Chaunochiton* distinct but always irregular columellae are developed.

The footlayer is generally present, visible in the mesocolpia in *Chaunochiton*. This layer is often



sculptured on the inner side of the apertural margin. The footlayer is especially thick when the endexine is missing (*Coula*, *Minquartia*, *Ochanostachys*, *Schoepfia* p.p., *Ximenia*). The endexine is mostly confined to the apertural areas, except in *Anacolosia*, *Cathedra*, *Chaunochiton* and *Phanerodiscus* in which the endexine is thick and continuous, and in *Erythropalum*, *Heisteria*, *Schoepfia* p.p., *Scorodocarpus* and *Strombosia* in which the endexine is very thin and continuous in the mesocolpia.

The tricolpate isopolar pollen types of Group A, found in *Coula*, *Curupira*, *Heisteria* p.p., *Aptandropsis* and *Minquartia*, and the tricolporate pollen types of Group A, found in *Diogoia*, *Strombosiopsis* and *Tetrastylidium* are considered primitive.

Porate types in *Aptandra*, *Brachynema*, *Dulacia*, *Harmandia*, *Olex* p.p., *Ongokea* and *Ptychopetalum* p.p. as well as 6-diploporate grains characterizing *Anacolosia*, *Cathedra*, *Phanerodiscus* and *Ptychopetalum* p.p. are probably derived.

The heteropolar-tetrahedral pollen grains of *Schoepfia* and the brevicolpate grains of *Chaunochiton* with its ectexinal ridges seem morphologically isolated and may also represent derived types.

*Intergeneric relationships.* *Couleae* and *Heisterieae* p.p. (*Heisteria*, *Aptandropsis*) are pollen morphologically related. The mutual affinities between *Heisteria* and *Chaunochiton* are weakly expressed in aperture characters and by the loss of the tectum in the intercolpium, and this last genus could be placed in a separate tribe of its own.

*Anacolosae* fall into two quite distinct generic groups, I, *Diogoia*, *Scorodocarpus*, *Strombosia*, *Strombosiopsis*, *Tetrastylidium* and II, *Anacolosia*, *Cathedra* and *Phanerodiscus*. *Brachynema* is isolated.

Within *Olaceae*, the pollen of *Ptychopetalum* is very distinct from that of *Olex* and *Dulacia*. It is distinct also from that of *Anacolosia*.

Pollen of *Aptandreae* (*Aptandra*, *Harmandia* and *Ongokea*) is uniform.

The morphology of *Schoepfieae* offers no clue to its affinities, but the ultrastructure of the exine draws them near to the *Couleae*.

*Relationship of family.* *Olacaceae* pollen shows resemblance to *Opiliaceae* and *Santalaceae* pollen. Some similarity also exists between the pollen of the *Olacaceae* and *Icacinaceae*.

*Fossil occurrences.* Pollen of the *Anacolosia* type is known from the Maestrichtian onwards, while *Olex* type pollen has been recorded from the lower Eocene. The pollen of *Ximenia* has been found in Quaternary sediment in East Africa.

*Literature:* R. BONNEFILLE, D. LOBREAU-CALLEN & G. RIOLLET, J. Biogeogr. 9 (1982) 469–486; G. ERDTMAN, Pollen morphology and plant taxonomy, Angiosperms (1952) 295–297; S. FEUER, Pollen morphology and evolution in the *Santalales* s. str. Thesis Univ. Mass. (1977), Amer. J. Bot. 65 (1978) 759–763; D. LOBREAU-CALLEN, Adansonia sér. 2, 20 (1980) 29–89; Bot. Jahrb. 103 (1982) 371–412; Bull. Lab. Géol. Genève (1983) in press; J. MULLER, Bot. Rev. 47 (1981) 84; C. REED, Mem. Soc. Brot. 10 (1955) 29–79. — D. LOBREAU-CALLEN.

*Chromosomes.* Only in the allied *Santalaceae* species of a fair number of genera have been examined; this yielded  $2n = 20, 24, 30, 38, 40$ , and  $72$ .

The two species of *Olacaceae* examined, one in *Heisteria* and one in *Strombosia*, yielded  $2n = 38$  and  $40$  respectively. The one species examined in *Opiliaceae*, viz. of *Opilia*, showed  $2n = 20$ . Although the evidence is small, it does support the affinity between the three families.

*Literature:* AN.A. FEDOROV (ed.), Chromosome numbers of flowering plants. Leningrad (1969).

*Taxonomy.* The family as a whole is characterized by a free basal central placenta from which a single ovule is pendent into each of the generally imperfect cells of the ovary, or in case of a 1-celled ovary, several ovules from the apex of such a free placenta. The ovules are bitegmic, or more often unitegmic, or have — mainly in parasitic species — no integument at all. The ovary is hypogynous in principle, but may become semi-hypogynous or even epigynous by concrecence with the calyx, disk or flower-axis. The fruit is drupaceous, not rarely  $\pm$  included by the accrescent calyx or disk.



*Olacaceae* are regarded by ENGLER (Syllabus, 1924) to represent the most primitive family of the *Santalales* with regard to the occurrence of hemiparasitism and the reduction in number of the integuments. ENGLER has divided the family in the first edition of ENGLER & PRANTL, Nat. Pfl. Fam. (III, 1, 1894; Nachtr. 1, 1897; Nachtr. 3, 1908) into 3 subfamilies with 6 tribes mainly on the base of the presence or absence of integuments and the position of the micropyle on the ovulum. These subdivisions have been maintained by the author in the second edition, 16b (1935). However, the characters used by ENGLER to distinguish subfamilies were based on too scanty observations to prove the constancy needed for such high taxonomic rank as that of a subfamily.

Characters may prove more variable than assumed; for example AGARWAL (Phytomorphology 13, 1963, 185) found that in *Olox* both unitegmie and ategmie species occur, which means that more observations in embryology are needed.

The tribes distinguished by ENGLER are mainly based on the presence or absence of starch and/or fatty constituents in the endosperm, and on the amount of fusion between the stamens. These tribes are not well established as the mentioned chemical constituents are not fully known yet in all members of the genera concerned. At the moment a subdivision of *Olacaceae* into natural subfamilies and tribes is still open.

Uses. *Scorodocarpus borneensis* provides a deep red timber (*kulim*). The timber of other genera (*Anacolosia*, *Strombosia*) is less important, usually of small size, and only locally used. *Ximenia americana* has a hard yellowish wood similar to Sandal wood, and is used locally. Young leaves of *Strombosia javanica* are eaten. Edible fruits are known of *Scorodocarpus borneensis* and *Ochanostachys amentacea*. The kernel of *Ximenia americana* contains a strong purgative.

Note. The most important paper on Malesian *Olacaceae* has been written by VALETON (Crit. Overzicht *Olacineae*; Inaug. Diss., Groningen, 1886). In a precursor I have given an account of the genera and species of Asia, Malesia and adjacent areas (Blumea 26, 1980, 145–168). All genera of this part of the world occur also in Malesia, with the exception of the monotypic genus *Malania* which is endemic in SW. China.

KEY TO THE GENERA  
based on flowering material

1. Leaves 3–5-plinerved, at base subpeltate. Climbing shrub; axillary tendrils often present
6. *Erythralium*
1. Leaves penninerved (if ± 3-plinerved a tree), never peltate. Tendrils absent.
2. Stamens and staminodes present
1. *Olox*
2. Stamens present; staminodes absent.
3. Stamens fully fused into a tube. Flowers unisexual, plant monoecious
2. *Harmandia*
3. Stamens not fused (sometimes partly adnate to the petals). Flowers generally bisexual.
4. Stamens 8 or 10, half of them epipetalous, the other half episepalous. Leaves usually mucronulate at apex. Spines and/or thorns generally present
3. *Ximenia*
4. Stamens all epipetalous. Leaves not mucronulate at apex. Spines and/or thorns absent.
5. Flowers interruptedly arranged in elongate spikes
4. *Ochanostachys*
5. Flowers arranged in short racemes, panicles, or mostly in fascicles.
6. Stamens 8 or 10, arranged in pairs before each petal
5. *Scorodocarpus*
6. Stamens 4–7, solitary before each petal.
7. Petals entirely free
7. *Strombosia*
7. Petals fused in the lower half.
8. Calyx cupular, ± truncate to very shortly 6-dentate. Petals thick-fleshy. Anthers apically penicillate
8. *Anacolosia*
8. Calyx indistinct, merely a rim with minute teeth. Flower supported by an epicalyx consisting of 3 conrescent bracts. Petals thin. Anthers not penicillate at apex
9. *Schoepfia*

KEY TO THE GENERA  
based on fruiting material

1. Leaves 3–5-plinerved, often subpeltate. Climber, often with axillary tendrils. Fruit long-stipitate narrowed to the base. Pericarp dehiscent, inside red. Seed blue ..... **6. Erythropalum**
1. Leaves penninerved (if  $\pm$  triplinerved a tree). Fruit at most very short-stipitate, usually rounded or obtuse at base. Seed whitish.
  2. Calyx indistinct, merely with a rim. Fruit inferior, supported by a persistent epicalyx consisting of 3 con- crescent bracts ..... **9. Schoepfia**
  2. Calyx distinct. No epicalyx.
    3. Calyx much enlarged in fruit.
      4. Enlarged calyx connate with the fruit only in its lower part, for the rest frill-like expanded, very large ..... **2. Harmandia**
      4. Enlarged calyx enveloping the fruit for its entire or almost entire length ..... **1. Olax**
    3. Calyx not accrescent in fruit.
      5. Disk much accrescent, adnate to and almost entirely covering the fruit (which bears the persistent calyx at its base!) ..... **8. Anacolosa**
      5. Disk, if present, not accrescent.
        6. Petiole very distinctly swollen distally ..... **5. Scorodocarpus**
        6. Petiole slightly or not thickened distally.
          7. Leaves usually mucronulate at apex. Axillary spines and ramal thorns may be present **3. Ximenia**
          7. Leaves not mucronulate at apex. Spines or thorns absent ..... **4. Ochanostachys**

KEY TO THE GENERA  
based on sterile material

1. Leaves usually mucronulate at apex, deciduous in the dry season. Branchlets usually with axillary spines and/or brachyblasts ending in thorns ..... **3. Ximenia**
1. Leaves not mucronulate at apex, persistent. Branchlets usually without, in *1. Olax pr. p.* sometimes with ramal thorns.
  2. Climbing shrubs
    3. Leaves subpeltate, 3–5-plinerved. Branches often with spring-like lignescent tendrils **6. Erythropalum**
    3. Leaves not subpeltate, exclusively pinninerved. Tendrils absent ..... **1. Olax pr. p.**
  2. Erect shrubs or trees.
    4. Leaves markedly distichous.
      5. Spines or thorns sometimes present ..... **1. Olax pr. p.**
      5. Spines or thorns absent ..... **2. Harmandia**
    4. Leaves indistinctly or not distichous.
      6. Petiole conspicuously thickened distally ..... **5. Scorodocarpus**
      6. Petiole hardly or not thickened distally.
        7. Leaves usually showing scattered blackish points on both faces; nerves slightly impressed above ..... **4. Ochanostachys**
        7. Leaves without such blackish points; nerves not properly impressed above.
          8. Leaves usually with numerous fine pellucid points visible against strong light ..... **7. Strombosia**
          8. Leaves not pellucid-punctate ..... **9. Schoepfia**

**1. OLAX**

LINNÉ, Sp. Pl. (1753) 34; ENGL. in E. & P. Nat. Pfl. Fam. 3, 1 (1889) 231; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 24; Blumea 26 (1980) 154. — *Drebbelia* ZOLL. Nat. Tijd. N. I. 14 (1857) 160; ENGL. in E. & P. Nat. Pfl. Fam., Nachtr. 2 (1900) 18. — **Fig. 1.**

Trees, shrubs or subshrubs, sometimes climbing, occasionally armed with ra-



mal thorns. *Leaves* spiral, sometimes (sub)distichous, penninerved. *Flowers* in racemes, panicles or spikes, rarely solitary. *Calyx* cup-shaped, truncate or obscurely dentate, small in anthesis, much accrescent in fruit. *Petals* 3, entire, or all or in part bipartite and thus seemingly 6 (rarely 5), inserted on a conical disk, free or connate in pairs. *Stamens* 8 (Mal.), partly adnate to the petals below, 3 of them fertile, and 5 staminodial (often bifid or bilobed, void of pollen); filaments flat; anthers oblong. *Ovary* superior, 1-celled, or 3-celled in the lower part only, with 3 anatropous uni- or ategmic ovules pending from the apex of a free central short placenta; style short or elongate; stigma capitate, 3-lobed. *Drupe* oblongoid or ovoid to subglobular, included halfway or to almost the top by the accrescent firmly membranous calyx, though not strictly connate with it; pericarp parenchymatose; endocarp stony. *Seed* mostly 1; albumen copious, containing oily substances.

Distr. About 40 (or less) *spp.* in the Old World tropics, subdivided by ENGLER into 4 African sections, and a fifth sect. *Triandrae* ENGL. which comprises both African *spp.* and all those found in Asia, *Malesia* (2 *spp.*), Australia, and the Pacific.

Ecol. Most species occur in drier vegetation types; a few are climbers; root-parasitism seems to be frequent.

Morphology. Cf. FAGERLIND, Beobachtungen über die Kletterorgane bei *Ola*x; Svensk Bot. Tidskr. 34 (1940) 26–34.

#### KEY TO THE SPECIES

1. Branchlets with a fine patent pubescence, usually armed with strong ramal thorns. Petals 7–9 mm, white, not or hardly changing colour in the dry state. Drupe c. 1.5 cm long ..... 1. *O. scandens*
1. Branchlets more or less glabrous, unarmed. Petals 10–12 mm, becoming dark to blackish in the dry state. Drupe 1.7–2.5 cm long ..... 2. *O. imbricata*

1. *Ola*x *scandens* ROXB. Pl. Corom. 2 (1798) 2, t. 102; MIQ. Fl. Ind. Bat. 1, 1 (1856) 785; MAST. Fl. Br. Ind. 1 (1875) 575; VALET. Crit. Overz. Olacin. (1886) 114; RIDL. Trans. Linn. Soc. London II, 3 (1893) 286; BACK. Fl. Bat. 1 (1907) 290; Voorl. (1908) 54; Schooffl. Java (1911) 222; RIDL. J. Str. Br. R. As. Soc. 59 (1911) 84; KOORD. Exk. Fl. Java 2 (1912) 172; KOORD.-SCHUM. Syst. Verz. 1 (1912) 2; BEUMÉE, Flor.-anal. Onderz. Djatibosschen (1922) 113; RIDL. Fl. Mal. Pen. 1 (1922) 421; HEYNE, Nutt. Pl. (1927) 592; BURK. Dict. (1935) 1578; BACK. & BAKH. f. Fl. Java 2 (1965) 64; SLEUM. Blumea 26 (1980) 157. — *O. obtusa* BL. Bijdr. (1825) 131; MIQ. Fl. Ind. Bat. 1, 1 (1856) 785. — *Drebbelia subarborescens* ZOLL. Nat. Tijd. N. I. 14 (1857) 160. — Fig. 1.

Shrub with pendent branches, or generally scandent, 2–20 m; stem 1–15 cm ø; bark rather smooth, grey; old branches with strong obtuse ramal straight or slightly curved thorns. Branchlets often horizontally spreading, patently puberulous or pubescent at younger parts, glabrescent below, striate-wrinkled longitudinally in dry specimens (not transversely ridged!). *Leaves* almost distichous, ovate-elliptic-oblong, apex broadly attenuate to rounded, base slight-

ly inequilateral, attenuate to obtuse, not rarely rounded and plicate, thin-coriaceous, dark to yellowish green, somewhat shining and glabrous above, initially short-pubescent at midrib beneath, glabrescent, 2–8 (–9.5) by (0.3–) 0.8–3.5 cm; nerves 5–8 pairs, unequal-spreading, rather inconspicuous on both faces as are the reticulations; petiole short-pubescent, 5–7 (–10) mm. *Racemes* 1–3 per axil, simple or branched, obliquely ascending, many-flowered, densely short-hairy, bracteate at base, 0.5–3.5 cm; bracteoles distichous, obtuse, keeled, pubescent, c. 2 mm, caducous; pedicels thickened at the very base, glabrous, 1–1.5 mm. *Calyx* cup-shaped, truncate, ciliolate, 0.5–1 mm high, c. 1.5 mm ø, much accrescent in fruit. *Petals* 3, of which 2 (rarely all) are split about halfway, thus 5(–6) petals seemingly present, linear-oblong, apex acute and incurved, glabrous, white, scented, 7–9 by c. 1.5 mm. *Stamens* 3, in the long-styled form reaching to the base of the sinus of the petals, in the short-styled form reaching 2–2.5 mm beyond it; filaments free for a short part; anthers oblong, c. 1.5 mm. *Staminodes* with very narrow void, deeply bifid cells. *Ovary* ovoid, glabrous; style either long (5–6 mm) or short (1.5–2.5 mm); stigma





Fig. 1. *Olax scandens* ROXB. In teak forest near Djombang, East Java (DE VOOGD 893).

obscurely 3-lobed. *Drupe* broadly ovoid to subglobose, covered for the lower 2/3 or more by the accrescent firmly membranous calyx, apiculate, orange to yellow (0.8–) 1.5 by (0.6–) 1 cm.

*Distr.* Widely distributed from Ceylon and tropical W. Himalayas through India, Burma, Indochina, Thailand; in *Malesia*: Malay Peninsula, Java incl. Kangean Is., Madura, Lesser Sunda Is. (Bali).

*Ecol.* Mostly in dry deciduous forest or scrub, also in teak forest, not rarely on rocky ground, often close to the sea (beach forest, dunes), rarely in light rain-forest, up to c. 300 m.

*Vern.* *Ganpi*, M (Antjol), *wangon*, J, *wuru wuru*, Md.

**2. *Olax imbricata* ROXB.** [Hort. Beng. (1814) 5, *nom. nud.*] Fl. Ind. 1 (1820) 169; ed. Carey 1 (1832) 164; DECNE, Nouv. Ann. Mus. Paris 3 (1834) 438; Herb. Timor. Descr. (1835) 110; ZOLL. & MOR. Syst. Verz.

(1846) 25; A. GRAY, U.S. Expl. Exp. Bot. (1854) 305; MIQ. Fl. Ind. Bat. 1, 1 (1856) 785; MAST. Fl. Br. India 1 (1875) 575; F.-VILL. Nov. App. (1880) 45; VIDAL, Sin. Atlas (1883) 20, t. 30, f. A; Phan. Cuming. Philip. (1885) 102; Rev. Pl. Vasc. Filip. (1886) 85; VALET. Crit. Overz. Olacin. (1886) 115; CERON, Cat. Manila (1892) 45; KING, J. As. Soc. Beng. 64, ii (1895) 99, *p.p.*; HOCHR. Bull. Inst. Bot. Btzg 11 (1904) 38; MERR. Govt. Lab. Publ. Philip. 27 (1905) 32; Philip. J. Sc. 1 (1906) Suppl. 51; BACK. Fl. Bat. 1 (1907) 292; Voorl. (1908) 54; MERR. Philip. J. Sc. 3 (1908) Bot. 80; BACK. Schoolfl. Java (1911) 222; MERR. Fl. Manila (1912) 185; KOORD. Exk. Fl. Java 2 (1912) 171; MERR. Sp. Blanc. (1918) 134; En. Born. (1921) 242; RIDL. Fl. Mal. Pen. 1 (1922) 421; MERR. En. Philip. 2 (1923) 116; SCHELLENB. Bot. Jahrb. 58 (1923) 158; BAKH. Bull. Jard. Bot. Btzg III, 15 (1936) 49; BACK. & BAKH. f. Fl. Java 2 (1965) 64; SLEUM. Blumea 26 (1980) 156. — *O. multiflora* A. RICH. ex



BAILL. *Adansonia* 3 (1862) 121. — *Pseudaleia imbricata* (ROXB.) HASSK. ex VALET. Crit. Overz. Olacin. (1886) 115, *pr. syn.* — *Pseudaleia longistylis* HASSK. ex VALET. *l.c.*, *pr. syn.* — *O. semiinfera* VALET. *l.c.* 116; MERR. En. Born. (1921) 242. — *O. laxiflora* RIDL. Kew Bull. (1931) 34. — *O. multiflora* RIDL. *l.c.* — *O. rosea* RIDL. *l.c.* 33; SINCLAIR, Gard. Bull. Sing. 14 (1953) 31.

Shrub, usually climbing; branchlets unarmed, striate, somewhat pubescent initially, practically glabrous, dark red-brown when dry; lenticels pale. *Leaves* ovate- to elliptic-oblong, apex subacuminate, acute or blunt, base cuneate or rounded, (sub)coriaceous, shining above, glabrous on both faces, 4–15 (–18) by 2–7.5 cm, nerves 6–9 pairs, rather irregularly curved-ascending, sometimes less in number and more steeply ascending, slightly raised beneath; petiole wrinkled, 5–10 mm. *Racemes* branched from the base, many-flowered, 1–3 (–5) cm; floral bracts ovate, concave, imbricate in 2 rows when young, caducous, 2–3 mm. *Calyx* very small. *Petals* 3, linear-oblong, white or pinkish, 10–12 mm. *Stamens* 3; staminodia 5 or 6, bifid. *Drupe* subglobose, rarely

oblongoid or obovoid, almost completely covered by the thin accrescent orange calyx, 1.7–2.5 cm. Otherwise as in *O. scandens*.

*Distr.* India, Ceylon, Burma, Andaman & Nicobar Is., Thailand, S. China (Hainan); in *Malesia*: Sumatra, Malay Peninsula, Java incl. Madura, Borneo, Celebes (incl. Kabaena & Buton Is.), Philippines (incl. Sulu Arch.), Lesser Sunda Is. (Flores, Sumbawa, Alor, Timor), Moluccas (Tanimbar & Kei Is.), New Guinea; also known from Formosa (Botel Tobago), Micronesia (Palau), and the Solomon Is.

*Ecol.* In primary, also often in secondary forest, dry brushwood, on coral limestone, but also occasionally in mangrove or peat swamp, at low elevations, rarely up to 900 m.

*Vern.* Philippines: *balagon*, *labnót*, P. Bis., *bitón*, *malabágio*, *malabútong*, Tag., *ubet-ubet*, Ilk.; Lesser Sunda Is.: *leténg*, Flores.

#### Excluded

*Olex sumatrana* MIQ. Fl. Ind. Bat. Suppl. (1860) 342 = *Cansjera scandens* ROXB. (*Opiliaceae*).

## 2. HARMANDIA

PIERRE ex BAILL. Bull. Soc. Linn. Paris 2 (1889) 770; BAILL. Hist. Pl. 11 (1892) 452; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 30; Blumea 26 (1980) 153. — **Fig. 2.**

Monoecious tree. *Leaves* distichous, penninerved, with infrequent laticifers. *Racemes* corymbiform, short. *Calyx* in anthesis small, patelliform, shortly 4-dented, much accrescent afterwards to form a frill which includes the fruit below. *Petals* 4 in the ♂, 6–8 in the ♀, connate to an urceolate tube for the lower 3/4, free above in form of 4 lobes. *Disk* extra-staminal, annular, crenulate, thin, finally disappearing. — ♂ *Flowers*: Stamens 4, epipetalous; filaments fused to a tube which bears the free anthers on top; connective thick. Ovary rudimentary. — ♀ *Flowers*: Staminodial tube without anthers. Ovary pyramidal, 1-celled, with 2 (unitegmic or naked?) ovules pendent from the short basal placenta; style short-conical; stigmas 3, sessile. *Fruit* drupaceous, concrescent with the much enlarged calyx below; pericarp fleshy; endocarp thin-woody. *Seed* 1, containing exclusively oil; embryo excentrically at apex of endosperm.

*Distr.* Monotypic. Indochina; in *Malesia*: Sumatra, Malay Peninsula, and Borneo. **Fig. 3.**  
*Ecol.* Lowland forest.

**1. *Harmandia mekongensis*** PIERRE ex BAILL. Bull. Soc. Linn. Paris 2 (1889) 770; PIERRE, Fl. For. Coch. (1892) t. 264; GAGN. Fl. Gén. I.-C. 1 (1911) 818, f. 95; Suppl. (1948) 739. — *H. kunstleri* KING, J. As. Soc. Beng. 64, ii (1895) 100; RIDL. Fl. Mal. Pen. 1 (1922) 421; HENDERS. Gard. Bull. S. S. 4 (1928) 238;

HEYNE, Nutt. Pl. (1927) 674 ('*Hernandia*') (cf. KOSTERM. Reinwardtia 2, 1953, 360); DESCH. Mal. For. Rec. 15, 2 (1954) 414; BALAN MENON, Mal. For. 24 (1961) 292 (wood); WHITMORE, Tree Fl. Malaya 2 (1973) 301, f. 1; SLEUM. Blumea 26 (1980) 153. — **Fig. 2.**

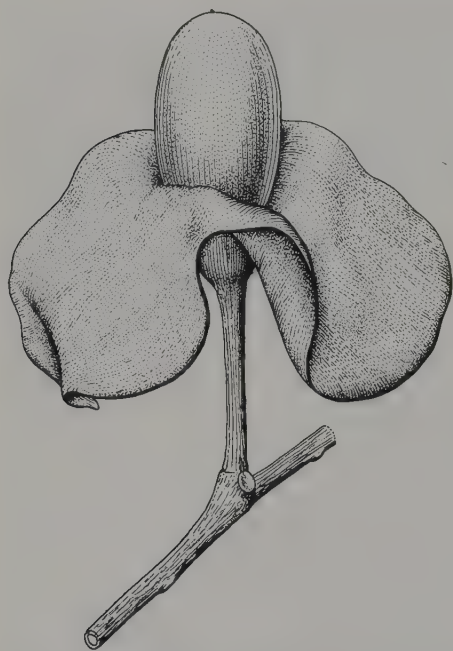


Fig. 2. *Harmandia mekongensis* PIERRE. Mature fruit with accrescent calyx,  $\times 2/3$  (VAN BALGOOY 2559).

Glabrous monoecious tree (6–)10–22(–40) m, fluted towards the base; bark pale fawn, greenish or whitish, flaky and corky; slash of inner bark whitish to pale yellow, granular; wood pale yellow. Branchlets slender, striate, zig-zag, older parts with linear lenticels. *Leaves* distichous, oblong or elliptic, sometimes lanceolate, short-acuminate, base cuneate to obtuse or rounded, (sub)coriaceous or parchment-like, shagreened from minute warts especially beneath, dull and brittle in the dry state, 5–7 (–9) by 2.5–4 cm, nerves (5–) 6–8 (–10) pairs, rather inconspicuous on both faces; petiole 3–4 mm. *Inflorescences* racemose-corymbiform, c. 5-flowered, 1–1.5 cm; bracts scaly, minute. *Flowers* small, green. *Calyx* cupular and low initially, hardly sinuate-dented,

very much accrescent in fruit. *Petals* connate below, forming a thickish urceolate corolla, 2 mm. — ♂ *Flowers*: Stamens 4; filaments connate to a fleshy tube, 1.5 mm; anthers cordate, 0.5 mm. Rudiment of ovary generally present. — ♀ *Flowers*: Staminodial tube without anthers. Ovary conical, tapering to a short style; stigmas 3, sessile. *Drupe* ovoid-ellipsoid, orange below, glaucous-green above, purple-black with a waxy bloom when dry, 2.5 (–3) by 1.3 (–2) cm, connate for c. 1 cm at the base with the enlarged persisting calyx which is free and collar-like spreading above, green turning yellow or pink-orange at maturity, 5–8 (–11) cm across, (1–) 2–3 (–4) cm high. *Seed* 1; pericarp fleshy, 0.5 mm; endocarp ligneous, 0.5 mm.

*Distr.* Indochina (Laos, Annam); in *Malesia*: Sumatra (Atjeh: G. Leuser Nat. Res.; Palembang: Rawas), Malay Peninsula (Perak, Pahang, Trengganu, Selangor, Negri Sembilan, Malacca), and Borneo (Sabah: Keningau Distr.). Fig. 3.



Fig. 3. Range of *Harmandia* PIERRE ex BAILL.

*Ecol.* In primary lowland forest, hilly country, up to 300 m, apparently rare. The fruits are eaten by animals.

*Vern.* *Mempudu tanah*, M, *kayu tadji*, Palembang.

### 3. XIMENIA

LINNÉ, Sp. Pl. ed. 1 (1753) 1193; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 22; Blumea 26 (1980) 166. — Fig. 4.

Shrubs or low trees; branches usually armed with axillary spines; brachyblasts often ending in thorns. *Leaves* spiral, sometimes fascicled on brachyblasts, pen-



nerined. *Inflorescences* axillary or at the end of brachyblasts, arranged in rather few-flowered peduncled, sometimes umbel-like cymes, or in fascicles, rarely solitary; bracts small. *Flowers* usually bisexual, rarely functionally unisexual. *Calyx* small, cupular-expanded, 4 (–5)-dentate, persistent, hardly or not accrescent in fruit. *Petals* 4 (rarely 5), free, linear-oblong, finally revolute about half-way, with a brush of hairs on the inner surface. *Stamens* 8 (rarely 10), free, hypogynous, alternately epipetalous and episepalous; filaments filiform; anthers linear-oblong to subovate, basifixed, dehiscent lengthwise; connective thick. Disk 0. *Ovary* sessile, superior, (3–) 4-locular; style slenderly columnar, as long as ovary; stigma small, capitate; ovules anatropous, bitegmic, solitary in each cell, pendulous from a free basal placenta. *Fruit* superior, drupaceous, with a rather thin pulpy pericarp, and a crustaceous to woody endocarp. *Seed* 1; endosperm copious, containing oily substances; embryo very small.

Distr. 8 spp. in the (sub)tropics, rather closely allied to each other, one of them (*X. americana*) pantropical and -subtropical.

Ecol. In thickets along the sea-shore, or in dry forests, mainly at low elevations.

**1. *Ximenia americana*** LINNÉ, Sp. Pl. (1735) 1193; DECNE, Herb. Timor. Descr. (1835) 111; BL. Mus. Bot. Lugd.-Bat. 1 (1850) 247; MIQ. Fl. Ind. Bat. 1, 1 (1856) 786; Suppl. (1860) 136; MAST. Fl. Br. India 1 (1875) 574; BECC. Nuov. Giorn. Bot. Ital. 9 (1877) 278, t. 11, f. 1–11; F.-VILL. Nov. App. (1880) 45; BISCHOP GREVELINK, Pl. Ned. Ind. (1883) 221; HEMSL. Rep. Challenger Bot. 1, 3 (1884) 132; VALET. Crit. Overz. Olacin. (1886) 74, t. 2, 20–22; WARB. Bot. Jahrb. 13 (1891) 299; SCHIMP. Ind. Mal. Strandpfl. (1891) 176; KING, J. As. Soc. Beng. 64, ii (1895) 107; VALET. in Koord. Minah. (1898) 391; RIDL. J. Str. Br. R. As. Soc. 32 (1900) 61; K. & V. Bijdr. Booms. Java 5 (1900) 280; K. SCH. & LAUT. Fl. Schutzgeb. (1901) 301; MERR. Philip. J. Sc. 1 (1906) Suppl. 190; VALET. Pl. Pap. (1907) 8; BACK. Fl. Bat. 1 (1907) 288; Voorl. (1908) 53; FOXW. Philip. J. Sc. 4 (1909) Bot. 450; BACK. Schoolf. Java (1911) 222; GAGN. Fl. Gén. I.-C. 1 (1911) 814; KOORD. Exk. Fl. Java 2 (1912) 172; RECHINGER, Bot. Ergebn. Wiss. Reise Salomon Ins. (1913) 107; MERR. Int. Rumph. (1917) 209; BROWN, Minor Prod. Philip. For. 2 (1921) 274, f. 23; RIDL. Fl. Mal. Pen. 1 (1922) 424; MERR. En. Philip. 2 (1923) 117; SCHELLENB. Bot. Jahrb. 58 (1923) 158; CRAIB, Fl. Siam. En. 1 (1926) 269; HEYNE, Nutt. Pl. (1927) 592; WHITE, J. Arn. Arb. 10 (1929) 211; RIDL. Kew Bull. (1931) 33; BOOBERG, Bot. Jahrb. 66 (1933) 13; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 23, f. 11; CORNER, Wayside Trees (1940) 728; HOLTH. & LAM, Blumea 5 (1942) 178; QUIS. Medic. Pl. Philip. (1951) 253; BACK. & BAKH. f. Fl. Java 2 (1965) 64; SLEUM. Blumea 26 (1980) 166. — *Vidara littorea* RUMPH. Herb. Amboin. 2 (1741) 119, t. 37. — *X. loranthifolia* SPAN. Linnaea 15 (1841) 177; Ic. Ined. t. 44. — *Zizyphus lit-*

*torea* TEYSM. ex HASSK. Abh. Naturf. Ges. Halle 9 (1866) 176, *nom. nud.* — Fig. 4.

*var. americana*: DEFILIPPS, Bot. Soc. Broter. II, 43 (1969) 195.

Glabrous sprawling or low-branching shrub or tree, up to 10 m; bark greyish brownish. Branchlets usually spiny, covered with red cork and roundish lenticels. *Leaves* often closely arranged on short lateral twigs, deciduous in the dry season, variable in shape, size and texture, narrowly to broadly lanceolate, ovate, elliptic, obovate or sometimes suborbicular, generally obtuse on both ends, though apex generally minutely apiculate or mucronulate, and sometimes emarginate, (sub)coriaceous, yellowish green, turning brownish blackish and becoming brittle in drying, (2–) 2.5–5 (–8, –10) by (1–) 2–3 (–4, –6) cm; nerves 3–5 (–7) pairs, rather faint; petiole 3–7 (–10) mm. *Inflorescences* axillary or near the ends of short lateral branchlets (brachyblasts) in form of subumbellate racemes or cymes, peduncled up to 1.5 cm, 3–9-flowered, up to 2.5 cm, pedicels ebracteolate, 3–7 (–12) mm. *Flowers* usually bisexual, white to greenish, fragrant. *Calyx* cupular, subacutely 4(–5)-toothed, ciliate, 0.5–1.5 mm. *Petals* 4 (5), linear-oblong, acute to rather obtuse, finally recurved for about half their length, white-barbate inside, (5–) 8–10 (–12) by 1.5–2 mm. *Stamens* 8 (10); filaments 2.5–4 mm, sigmoid near apex; anthers 2–4 mm; connective apiculate. *Ovary* ovoid-conical; style filiform, up to 5 mm. *Drupe* plum-like, subglobose to ellipsoid, rarely ovoid, apiculate, yellow to orange or scarlet, (1.7–) 2.5 (–3.5) by 1.5–3 cm; pericarp pulpy, green; endocarp bony. *Seed* 1, 1.5–2.5 by 1.2–2 cm.



Fig. 4. *Ximenia americana* L. var. *americana*. South coast of New Guinea (photogr. C. KALKMAN).

Distr. Pantropical and -subtropical.

Ecol. In thickets immediately back of the beach along sea-shore (*Barringtonia* formation), also in dry savannah or forest, sometimes even in light rain-forest, scattered, on stony or sandy ground; facultative root-parasite and auto-parasite.

*Dispersal.* The succulent pericarp is eaten by birds. The kernel is light enough to float, and there is, in addition, a layer of air-bearing tissue beneath the shell which allows the fruit to be water-borne for months (GUPPY, Plant seeds and currents W. Indies, 1917,

252; DEFILIPPS, Webbia 30, 1976, 180).

Taxon. *Ximenia americana* comprises numerous local forms of doubtful taxonomic significance.

Uses. Wood hard, close-grained, used as a substitute for white Sandal wood, because of its yellowish brownish colour. The sour pulp of the fruit is eaten. The kernels are purgative, a fact already stated by RUMPHIUS.

Vern. *Bédara laut*, *bidari*, *pidaroh*, M; Philippines: *bo-o*, Samar I., *pangungán*, Yak., *paniungán*, Sul., *sulo-sulo*, Bag.

#### 4. OCHANOSTACHYS

MAST. Fl. Br. India 1 (1875) 576; ENGL. in E. & P. Nat. Pfl. Fam. Nachtr. 3 (1908) 99; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 12; Blumea 26 (1980) 153. — *Petalinia* BECC. Malesia 1 (1883) 257. — Fig. 5.

Tree. *Leaves* spiral, penninerved; hairs, if any, of a dendritic type. *Spikes* simple or sometimes 1- or 2-branched, elongate, slender, the bisexual flowers interruptedly solitary or arranged in groups of 2–4. *Calyx* small, cup-shaped,





Fig. 5. *Ochanostachys amentacea* MAST. a. Habit,  $\times 3/5$ , b. flowerbud, c. flower, two petals removed, both  $\times 8$ , d. fruit,  $\times 1\ 1/5$  (a-c VAN BALGOOY 2524, d FRI 13320).

4–5-toothed, not accrescent. *Petals* (3–) 4 (–5), free to almost the base. *Stamens* generally 2, rarely 1 or 3 before each petal and adherent to its base; filaments linear-subulate; anthers subglobular-didymous. *Staminodes* 0. *Disk* hypogynous, fleshy, shallow, rather inconspicuous. *Ovary* superior, incompletely (2–) 3 (–4)-celled below, 1-celled above; ovules bitegmic, each one pendent from the top of a free basal placenta into the cell; style short, cylindric; stigma minute, 3-lobed. *Drupe* subglobose; pericarp thin; endocarp woody. *Seed* 1, mainly containing starch, and very little fatty substances in the form of oil-droplets; embryo very small in the apex of the endosperm.

Distr. Monotypic, endemic in *Malesia*: Sumatra, Banka, Malay Peninsula, and Borneo. Fig. 6. Ecol. In lowland rain-forest.

**1. *Ochanostachys amentacea* MAST.** Fl. Br. India 1 (1875) 577; VALET. Crit. Overz. Olacin. (1886) 104; BOERL. Handl. 1 (1890) 207; KING, J. As. Soc. Beng. 64, ii (1895) 100; RIDL. J. Str. Br. R. As. Soc. 33 (1900) 60; HOOK. Ic. Pl. 27 (1901) t. 2689; HOCHR. Bull. Inst. Bot. Btzig 22 (1905) 44; FOXW. Philip J. Sc. 4 (1909) Bot. 449 (wood); WINKL. Bot. Jahrb. 49 (1913) 365; MERR. En. Born. (1921) 242; RIDL. Fl. Mal. Pen. 1 (1922) 422, f. 42; S. MOORE, J. Bot. 62 (1924) Suppl. 21; HEYNE, Nutt. Pl. (1927) 593; FOXW. Mal. For. Rec. 3 (1927) 119, with plate; HENDERS. Gard. Bull. S. S. 4 (1928) 238; MERR. Pl. Elm. Born. (1929) 58; RIDL. Kew Bull. (1931) 35, incl. var. *rufa* STAPF ex RIDL.; DESCH. Mal. For. Rec. 15, 2 (1954) 415, pl. 86, f. 1 (wood); BROWNE, For. Trees Sarawak & Brunei (1955) 281; STAUFF. Vierteljahrschr. Nat. Ges. Zürich 106 (1961) 414; WYATT-SMITH & KOCHUM. Mal. For. Rec. 17 (1965) 309; SMYTHIES, Common Sarawak Trees (1965) 113; BURGESS, Timbers of Sabah, Sabah For. Rec. 6 (1966) 420 (wood); WHITMORE, Tree Fl. Malaya 2 (1973) 302, f. 2; MEIJER, Field Guide Trees W. Males. (1974) 222, f. 57; SLEUM. Blumea 26 (1980) 153. — *Petalinia bancana* BECC. Malesia 1 (1883) 258. — *O. bancana* (BECC.) VALET. Crit. Overz. Olacin. (1886) 104. — **Fig. 5.**

Tree, (5–) 10–30 (rarely –50) m high; bole straight, maybe fluted at base or shortly buttressed, 15–40 (rarely –80) cm ø; bark grey-brown to brown-red, shedding in thin irregular flakes to expose lighter coloured patches so that the whole trunk is characteristically mottled; slash of inner bark finely fibrous, yellow-brownish, interspaced with blackish fibres and discrete droplets of white latex. Branchlets glabrous or puberulous, rarely rufous-tomentellous-scurfy at tips. *Leaves* ovate to elliptic or elliptic-oblong, sometimes slightly inequilateral, apex short-acuminate, tip blunt, base broadly cuneate to rounded, subcoriaceous to coriaceous, usually glabrous, rarely rufous-tomentellous on the nerves beneath (Borneo), green and shining above, yellowish

green beneath when fresh, rather dull olivaceous-brownish when dry, usually sparsely shallowly tubercled on both faces, the tubercles (or slightly impressed dots) in part blackish, (5–) 6–13 by (2.5–) 3–7 cm; nerves (4–) 5 (–6, –8) pairs, curved-ascending, the upper ones inarching before the edge, slightly though distinctly impressed above, much raised beneath in dry specimens, transverse veins and reticulation of veinlets rather inconspicuous; petiole (1–) 1.5–2 (–3) cm, not or hardly thickened distally. *Spikes* erect-ascending, (2–) 3–6 (–12) cm. *Flowers* arranged interruptedly, either solitary or mostly 2 or 3 together in opposite clusters, all over subglabrous or puberulous, rarely scurfy rufous-tomentellous (Borneo); bracts minute, ovate, acute. *Flowers* green to whitish-yellowish, subsessile, or pedicelled up to 1 mm. *Calyx* 4–5-toothed, 1 mm. *Petals* (3–) 4 (–5), ovate to ovate-oblong, with a few coarse hairs inside, 2.5 by 1.5 mm. *Filaments* white-greenish; anthers light brown. *Ovary* depressed-ovoid, lengthwise striate, glabrous; style short-cylindric. *Drupe* supe-

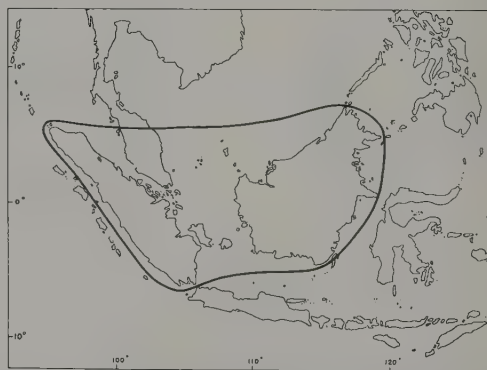


Fig. 6. Range of the genera *Ochanostachys* MAST. and *Scorodocarpus* BECC.



rior, subglobose, green turning yellow when fully ripe, pendulous, (1.5–) 2–2.5 (–3) cm ø, on a slender peduncle 2–3 mm; pericarp thin, exuding a milky gum, often tubercled outside, getting loose finally; endocarp woody, hardly 1 mm. *Seed* 1, subglobular.

*Distr.* *Malesia*: Sumatra, Banka, Malay Peninsula, Borneo. *Fig.* 6.

*Ecol.* Understorey tree in primary, also secondary lowland rain-forest, often in mixed Dipterocarp forest, undulating country, hillsides and ridges, up to

950 m, on loamy or sandy, rarely periodically inundated ground, scattered, or locally frequent.

*Uses.* The hard and durable yellowish to purple-brown wood is used for house constructions. The fruit is said to be edible.

*Vern.* Sumatra: *gaé, gai, goi*, Karo, *nahum, pë-taling, pëtikal, pimpin bulan, pitatar*, Minangk.; *kë-map*, Banka; Malaya: *këtikal, kuning, mahun, mën-tatai*, Kedah, *pëtaling*, the common Malay name; Borneo: *ëmpilang, ënticol, ëntikan, guru, pitotar, santikal*, Iban, *tanggal*, Dusan, *kadasan*, M.

## 5. SCORODOCARPUS

BECC. *Nuov. Giorn. Bot. Ital.* 9 (1877) 274, t. 11, f. 12–17; SLEUM. in E. & P. *Nat. Pfl. Fam.* ed. 2, 16b (1935) 20; Blumea 26 (1980) 160. — *Fig.* 7.

Trees. *Leaves* spiral, penninerved. *Flowers* bisexual, in short racemes. *Calyx* small, cupular, 4–5-crenate or -dentate, not enlarged in fruit. *Petals* 4 or 5, hypogynous, narrow, coherent by their edges until full anthesis, brush-like woolly inside. *Stamens* 8 or 10, adnate to the lower half of each petal in pairs, the uppermost part of the filaments remaining free as are the linear-elongate anthers. *Ovary* superior, imperfectly 3–4-celled, with 1 (uni- or bitegmic?) ovule pendent from the top of the almost free placenta into each cell; style elongate-conical; stigma minutely 3–4-lobed. *Drupe* medium-sized, subglobular, with a thin fleshy pericarp and a much thicker woody endocarp. *Seed* 1; albumen fleshy, containing starch and tannin.

*Distr.* Monotypic. Peninsular Thailand; in *Malesia*: Sumatra, Lingga Is., Malay Peninsula, and Borneo. *Fig.* 6.

*Ecol.* Lowland forest.

**1. *Scorodocarpus borneensis* (BAILL.) BECC.** *Nuov. Giorn. Bot. Ital.* 9 (1877) 274, t. 11, f. 12–17; VALET. *Crit. Overz. Olacin.* (1886) 89; BOERL. *Handl.* 1 (1890) 205; KING, J. *As. Soc. Beng.* 64, ii (1895) 108; RIDL. *J. Str. Br. R. As. Soc.* 33 (1900) 60; HOCHR. *Bull. Inst. Bot. Btzg* 22 (1905) 42; FOXW. *Philip. J. Sc.* 4 (1909) Bot. 449, pl. 22, f. 11 (wood); MERR. *En. Born.* (1921) 242; RIDL. *Fl. Mal. Pen.* 1 (1922) 424; BURK. & HENDERS. *Gard. Bull. S. S.* 3 (1925) 358; FOXW. *Mal. For. Rec.* 3 (1927) 121 & plates; HEYNE, *Nutt. Pl.* (1927) 593; DESCH. *Mal. For. Rec.* 15, 2 (1954) 418, f. 2 (wood); BROWNE, *For. Trees Sarawak & Brunei* (1955) 280; SYMTHIES, *Common Sarawak Trees* (1965) 113; WYATT-SMITH & KOCHUM. *Mal. For. Rec.* 17 (1965) 347; BURGESS, *Sabah For. Rec.* 6 (1966) 422 (wood); WHITMORE, *Tree Fl. Malaya* 2 (1973) 303, f. 3; MEIJER, *Field Guide Trees W. Males.* (1974) 224, f. 58; RAO, *Mal. For.* 38 (1975) 184, f. 1–5 (leaf anat.); SLEUM. *Blumea* 26 (1980) 160. — *Ximenia borneensis* BAILL. *Adansonia* 11 (1874) 271. — *Fig.* 7.

A large tree, 10–40 (rarely –60) m, 20–60 (–80, or more) cm ø, all parts reeking of garlic or onion especially after rain and from cut or bruised parts; crown dense; bole usually straight, notched, sometimes with small buttresses; bark grey to dark brown, fissured and thinly rectangularly flaky, inwards dark red with coarse orange flecks; wood hard, slash generally yellow to orange-brown, rarely whitish. Branchlets smooth and glabrous at tips, older parts dark coloured with elongate lenticels. *Leaves* generally elliptic-, rarely lanceolate-oblong, apex rather abruptly acuminate for 1–2 cm, base cuneate to rounded, entire, subcoriaceous to coriaceous, shining green above, paler beneath when fresh, dull olive-green when dry, glabrous, often densely minutely tubercled mainly on upper surface by spicular cells or sclereids which show remarkably in dry leaves, 7–15 (–22, –32) by 3–5 (–7, –12) cm; nerves 4–5 (–7) pairs, distant, curved-ascending (one marginal rather inconspicuous), flat above, much raised beneath as are the midrib and the transverse veins, reticulations

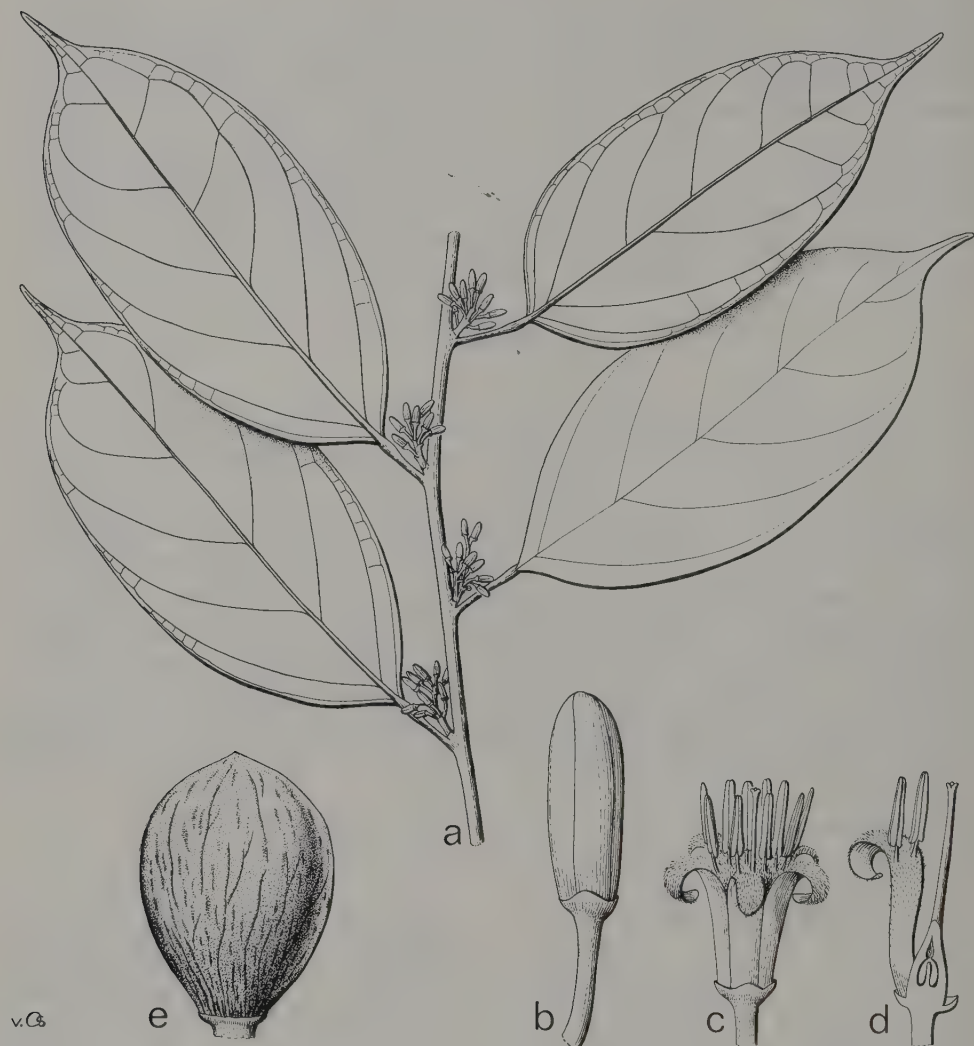


Fig. 7. *Scorodocarpus borneensis* BECC. *a.* Habit,  $\times \frac{1}{2}$ , *b.* flowerbud, *c.* flower, *d.* ditto, petals save one removed, all  $\times 3\frac{1}{2}$ , *e.* fruit,  $\times \frac{1}{2}$  (*a-d* FRI 4784, *e* FRI 17777).

rather faint; petiole swollen distally, 1–1.5 (–2) cm. *Racemes* rusty- to greyish-puberulous; rachis 2 (–4) cm; flowers along rachis either solitary or 2 or 3 in a group; pedicels 1.5–2 mm. *Calyx* small with wavy edge. *Petals* narrow-oblong, yellowish, pink or usually creamy white, 8–10 (–15) by 2 mm, brushed-woolly inside, finally reflexed. *Anthers* yellow, 3–4 mm. *Ovary* yellowish green, tapering to the thickish white style. *Drupe* superior globose to rather pear-shaped, with numerous vertical stripes or faint ribs in the dry state, glabrous, green, (3–) 4–5 (–7.5) cm

$\varnothing$ , on peduncle 1 by 0.5 cm; pericarp thin, fleshy; endocarp woody, 2–2.5 mm thick, wrinkled by an outer layer of numerous vertical fibre-like stony strands, and an inner one of compact stone cells. *Seed* 1, subglobular.

*Distr.* Peninsular Thailand and *Malesia*: Sumatra, Lingga Is., Malay Peninsula, and Borneo. Fig. 6.

*Ecol.* In primary, or often disturbed or secondary lowland forest, on flat (sometimes seasonally flooded) country or undulating hillsides, up to 600 (rarely –900) m, on sandy or clayey, rarely blackish



soil, scattered, but locally frequent.

Uses. A medium hardwood timber; wood of rather fine texture and fairly durable, purple-brown, used for constructions. The seeds are reported to be edible; they have a taste of onion.

Vern. Generally known as *kulim*, M; locally called *bawang hutan*, *maju bawang*, *kisindah*, *mar-sindu*, *sagad bërau*, Murut, *sëdau*, Kutei, *sinoh*, Iban *tëradu*, *ungsunah*, M.

## 6. ERYTHROPALUM

BL. Bijdr. (1826) 921; Fl. Jav. (1828) praefatio VII ('*Erythroropalum*'); HASSK. Cat. Hort. Bog. (1844) 191 ('*Erythropalla*'); SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 20b (1940) 401, f. 121; Blumea 26 (1980) 151. — *Monaria* KORTH. ex VALET. Crit. Overz. Olacin. (1886) 130, in syn. — **Fig. 8.**

Slender scandent shrub or liana, with axillary tendrils usually present. *Leaves* spiral or subdistichous, slightly peltate, 3–5-plinerved, long-petioled. *Flowers* very small, bisexual, or andro-dioecious, borne in loose, slender, peduncled and repeatedly dichotomous many-flowered cymes; bracts minute. *Calyx* cupular, with 4 or 5 short, broad, subimbricate teeth, the basal part accrescent and covering the fruit. *Petals* 5, ovate-triangular, coherent by their bases, recurved. *Stamens* 5, inserted at the base of the petals, each provided there with 2 lateral scales (or staminodes?); filaments very short; anthers ovate, introrse; connective thickish. *Disk* cup-shaped, 5-crenate. *Ovary* (rudimentary in the ♂) inferior, tapering to a short conical style with a minutely 3-lobed stigma, (2–) 3-celled below, 1-celled above; placenta central, free, with 2 or 3 unitegmic ovules pendent from its apex. *Fruit* drupaceous, crowned by the persistent calyx lobes and remains of the disk, ellipsoid, stipitate-contracted downwards; pericarp thin-fleshy; endocarp crustaceous to woody, splitting into 3–6 segments. *Seed* 1; embryo minute near the apex of the large albumen which contains oily substances.

Distr. Monotypic. Widely spread in S. India, and from the E. Himalaya to Assam, Bengal, Burma and the Andaman Is., in Indochina, Thailand, SW. China (incl. Hainan); in *Malesia*: Sumatra, Malay Peninsula, Borneo, Java, Lesser Sunda Is. (Flores), N. Celebes (Minahasa), Philippines, Talaud Is.

Ecol. In forest or forest borders at low and medium altitudes.

**1. *Erythropalum scandens*** BL. Bijdr. (1826) 922; HASSK. Pl. Jav. Rar. (1848) 193; MIQ. Fl. Ind. Bat. 1, 1 (1856) 704; MAST. Fl. Br. India 1 (1875) 578; VALET. Crit. Overz. Olacin. (1886) 130; BOERL. Handl. 1 (1890) 208; O.K. Rev. Gen. Pl. 1 (1891) 111; PIERRE, Fl. For. Coch. (1892) t. 269 f. A; KING, J. As Soc. Beng. 64, ii (1895) 130; RIDL. J. Str. Br. R. As. Soc. 33 (1900) 61; HOCHR. Bull. Inst. Bot. Btzg 19 (1904) 39; *ibid.* 22 (1905) 102; Ann. Jard. Bot. Btzg Suppl. 3, 2 (1910) 854, incl. var. *abbreviatum* HOCHR.; BACK. Schoolfl. Java (1911) 223; GAGN. Fl. Gén. I.-C. 1 (1911) 822, f. 96; KOORD. Exk. Fl. Java 2 (1912) 172; MERR. Philip. J. Sc. 14 (1919) 242; RIDL. Fl. Mal. Pen. 1 (1922) 436; MERR. En. Philip. 2 (1923) 118; BURK. & HENDERS. Gard. Bull. S. S.

(1925) 358; CRAIB, Fl. Siam. En. 1 (1926) 271; BARTLETT, Pap. Mich. Ac. Sc. 6 (1929) 49; MERR. Pl. Elm. Born. (1929) 58; BURK. Dict. (1935) 949; HOLTH. & LAM, Blumea 5 (1942) 78; GAGN. Fl. Gén. I.-C. Suppl. (1948) 741; BACK. & BAKH. f. Fl. Java 2 (1965) 65; HATUS. Fl. Batan I. (1966) 27; STEEN. Blumea 15 (1967) 153; SLEUM. Blumea 26 (1980) 151. — *Modeccopsis vaga* GRIFF. Notulae 4 (1854) 633. — *E. vagum* (GRIFF.) MAST. Fl. Br. India 1 (1875) 578; VIDAL, Phan. Cuming. Philip. (1885) 85; CERON, Cat. Pl. Herb. Manila (1892) 45. — *E. grandifolium* ELMER, Leaf. Philip. Bot. 8 (1915) 2788. — **Fig. 8.**

Scandent shrub or liana, glabrous, 3–10 m; stem flexible; tendrils often lignescence-thickened distally, simple, or rarely bifid. Branches slender, elongate,

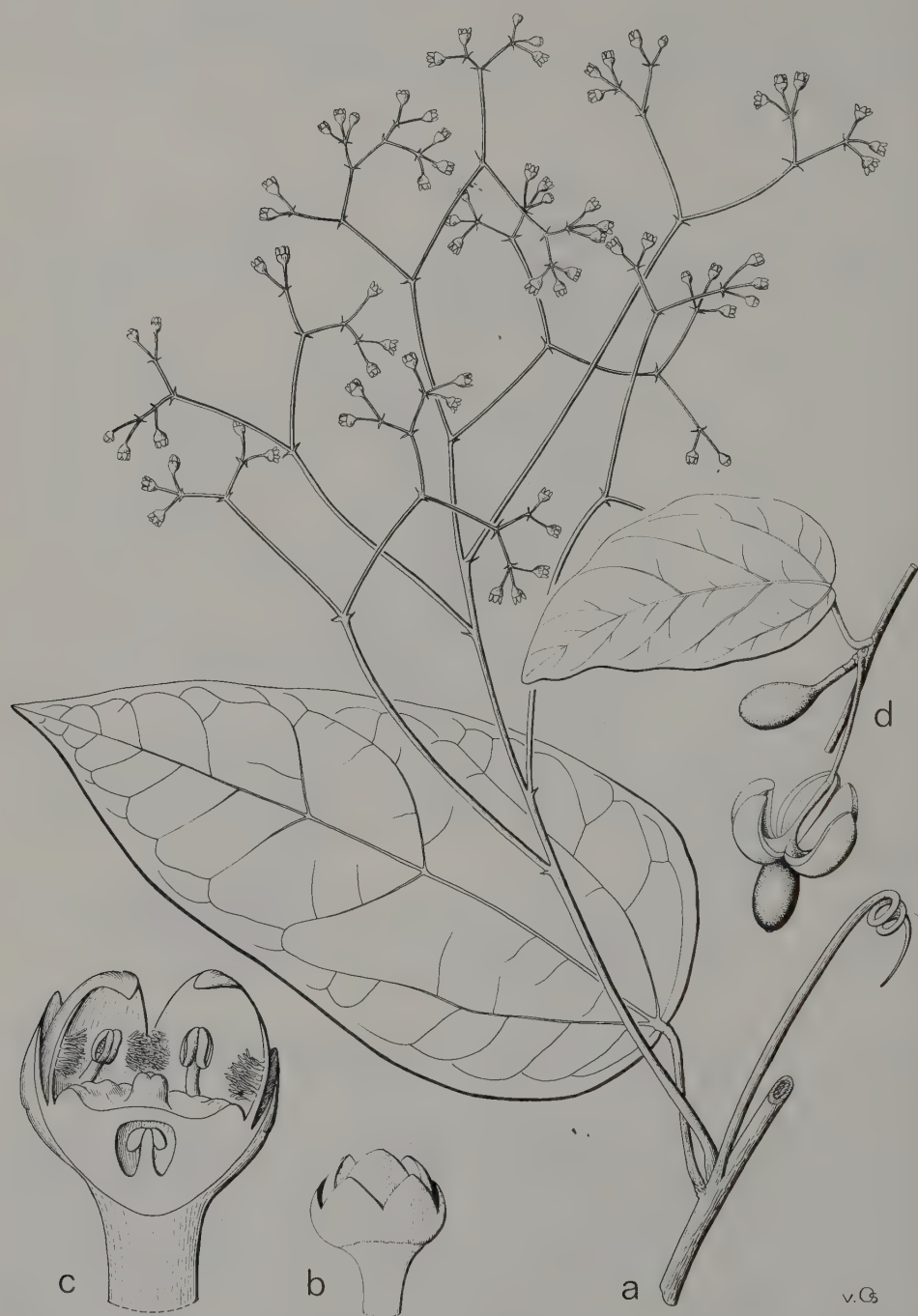


Fig. 8. *Erythropalum scandens* Bl. *a*. Habit,  $\times \frac{1}{2}$ , *b*. flowerbud,  $\times 5$ , *c*. flower, in section,  $\times 14$ , *d*. fruits, one dehiscent,  $\times \frac{1}{2}$  (*a-c* KERR 20888, *d* VAN STEENIS 12722).



sparingly rebranched, the free ends dropping; bark yellowish brownish, dotted with pale lenticels. *Leaves* variable in shape and size, triangularly ovate to ovate- or lanceolate-oblong, apex acuminate, tip acute, base broadly attenuate-truncate, rarely subcordate, mostly a little peltate, membranaceous to firmly chartaceous, rarely coriaceous, deep green above, glaucescent beneath when fresh, yellowish greenish in the dry state, fetid when bruised, (5–) 6–16 (–20, –25) by 6–12 (–15) cm; basal nerves 1 or 2 pairs, widely divergent and ascendent, 3–6 upper pairs spreading, prominent beneath, reticulations usually inconspicuous; petiole slightly thickened and wrinkled on both ends, (2–) 3–5 (–10) cm. *Inflorescences* peduncled, lax, very slender, repeatedly dichotomous and many-flowered cymes, up to 15 cm long, these sometimes reduced to subsessile rather few-flowered cymes or fascicles; pedicels filiform, 4–5 mm; bracts triangular-ovate, hardly 1 mm. *Calyx* cupular, 5-toothed, 1 (–1.5) mm. *Petals* 5, ovate-triangular, glabrous, 1.5–2 mm. *Stamens* with a tuft of hairs on either side; filaments very short; anthers ovate-cordate, c. 0.3 mm; connective thick. *Disk* pentagonous, rather flat, fleshy, crenulate, 1.5 mm  $\varnothing$ , elevated in the centre to form the short conical style with 3 small stigmas. *Drupe* pendulous, subglo-

bose to ellipsoid or obovoid-pyriform, stipitate-attenuate towards the base for 2–3 cm, crowned by the persistent calyx lobes and the remains of the disk, 1.5–2 (–2.5) by 1.5–2.5 cm; pericarp thin-fleshy, yellow to red, rarely whitish; endocarp crustaceous; finally stellately splitting from top downwards into 3–6 reflexed segments, inside red. *Seed* indigo blue, evil smelling.

Distr. S. India, E. Himalaya to Assam, Bengal, Burma, the Andaman Is., Indochina, Thailand, SW. China (incl. Hainan); in *Malesia*: Sumatra, Malay Peninsula, Borneo, Java, Lesser Sunda Is. (Flores), NE. Celebes (Minahasa), Philippines (incl. Sulu Arch.), Talaud Is.

Mentioned to occur in the Kei Is. (S. Moluccas) by WARBURG (Bot. Jahrb. 13, 1891, 299) possibly due to an erroneous identification. Sterile material can be (and has been) confused with *Cardiopteris moluccana* and with *Menispermaceae* (e.g. *Tinospora*).

Ecol. Scattered in the substage of lowland and submontane primary and secondary rain-forest or forest borders, in mixed Dipterocarp forest, rarely up to 2135 m.

Vern. *Kulim akar*, M, *aroy uat bankong*, S; Philippines: *balingayo*, *saynat*, Tag., *barak-barak*, Mbo., *pulipis*, Sub.

## 7. STROMBOSIA

BL. Bijdr. (1826) 1154; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 21; Blumea 26 (1980) 163. — *Lavallea* BAILL. *Adansonia* 2 (1862) 361. — **Fig. 9.**

Shrubs or trees; young twigs distinctly zig-zag. *Leaves* spiral, sometimes almost distichous, penninerved. *Flowers* bisexual, small, in shortly peduncled cymes or in sessile fascicles. *Calyx* a shallow cup, 5-lobed to various depth, showing a reddish brown prominent dot on tip of each lobe, subperigynous or perigynous, finally epigynous, accrescent, adnate to the pericarp almost to the top of the mature fruit. *Petals* (4–) 5, free, often reflexed at anthesis, hairy within. *Stamens* 5 (sometimes 4), epipetalous; filaments flat, adnate to the petals except for their uppermost part, and bearing numerous unicellular hairs; anthers didymous, dorsifixed. *Disk* hypogynous, prominent, (3–) 5-lobed. *Ovary* initially superior, finally partly inferior, i.e. partly sunken into the receptacle, almost entirely covered by the fleshy disk, 3–5 (–6)-celled below, 1-celled above; placenta free, central, from which 3–5 (–6) anatropous unitegmatic ovula are pendent; style short to filiform-elongate; stigma subglobular, rather obscurely 3–5 (–6)-lobed. *Drupe* crowned by the persistent calyx and style base; pericarp (the outer part of which is formed by the accrescent calyx) thin-fleshy; mesocarp crustaceous or woody. *Seed* 1, with a small embryo in the apex of the fleshy albumen which contains oily substances and amorphous polysaccharides.

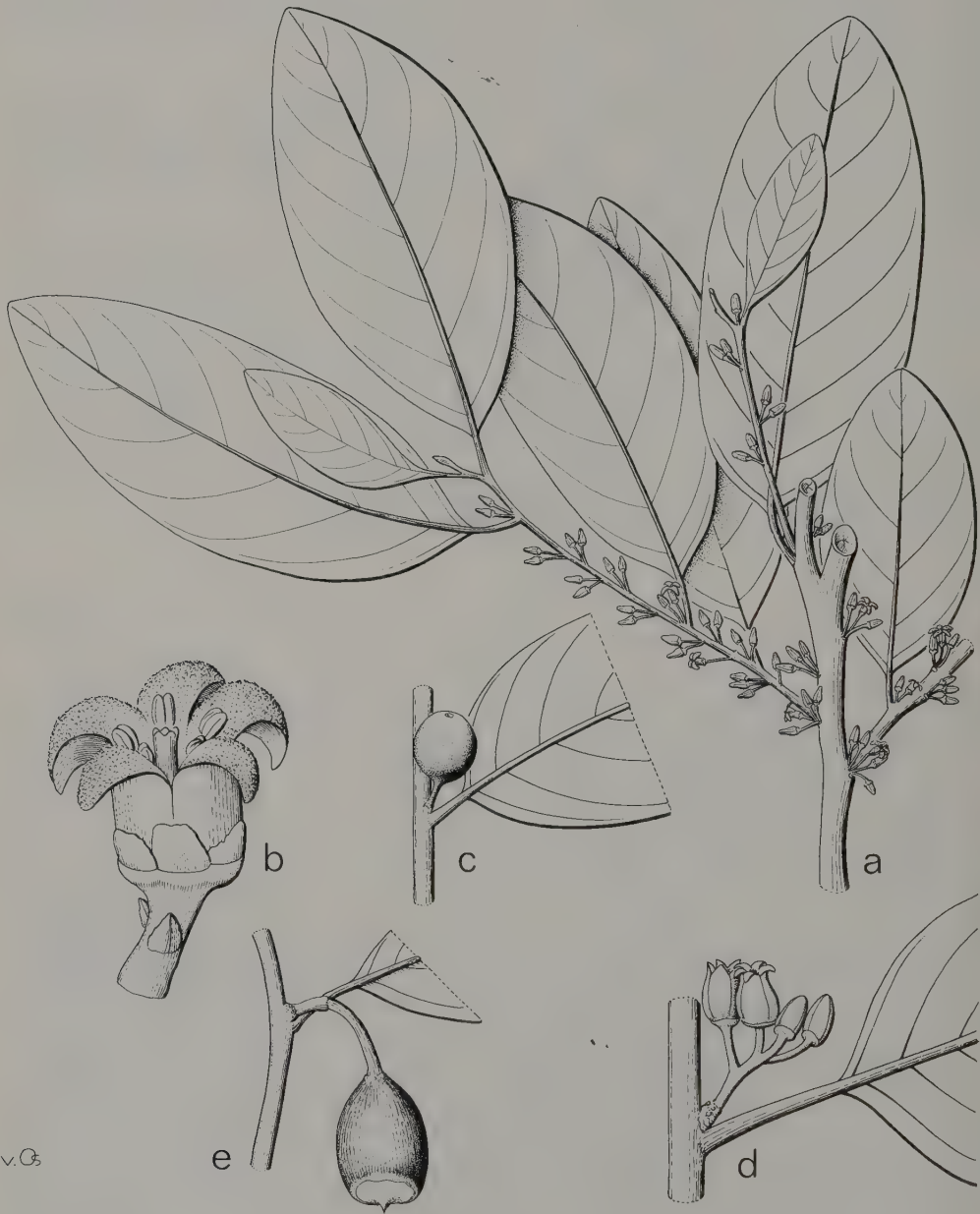


Fig. 9. *Strombosia ceylanica* GARDN. a. Habit,  $\times \frac{1}{2}$ , b. flower,  $\times 5$ , c. fruit,  $\times \frac{1}{2}$ . — *S. javanica* BL. d. Inflorescence,  $\times 1$ , e. fruit,  $\times \frac{1}{2}$  (a–b Cult. Hort. Bog. III-G-122a, c DE WILDE c.s. 16551, d KOSTERMANS 10593, e KOSTERMANS 9570).



Distr. About 12  *spp.*, c. 9 of which in tropical Africa, the rest in India (W. Peninsula) and Ceylon to Burma and Thailand; in *Malesia*: Sumatra, Malay Peninsula, Java, Borneo, the Philippines, and the N. Moluccas (Morotai).

Ecol. Lowland forest.

#### KEY TO THE SPECIES

1. Cymes peduncled for 0.5–1 cm. Bracts and bracteoles caducous in early anthesis. Petals (6–) 8–10 mm. Drupe obovoid-subturbinate, apex truncate, apiculate by the remaining hard style base. Leaves smooth on upper surface, not pellucid-punctulate ..... **1. *S. javanica***
1. Cymes or fascicles sessile. Bracts and bracteoles persisting into anthesis. Petals 2–5 mm. Drupe pyriform when young, subglobose at full maturity, apex obtuse-rounded; remains of calyx and style base inconspicuous
2. Leaves hardly or not pellucid-punctulate, their surfaces smooth. Petals 2 mm .... **2. *S. philippinensis***
2. Leaves generally distinctly pellucid-punctulate, their surfaces markedly parchment-like (shagreened) from tiny surface wrinkles or bumps, often glaucous-green and dull in dry specimens. Petals (2.5–) 3–4 (–5) mm ..... **3. *S. ceylanica***

**1. *Strombosia javanica*** BL. Bijdr. (1826) 1155; HASSK. Cat. Hort. Bog. (1844) 232; Pl. Jav. Rar. (1848) 238; BL. Mus. Bot. Lugd.-Bat. 1 (1850) 251, f. 47; MIQ. Fl. Ind. Bat. 1, 1 (1856) 787; MAST. Fl. Br. India 1 (1875) 579; VALET. Crit. Overz. Olacin. (1886) 86, pl. 1, 16 a–n, incl. *var. sumatrana* VALET.; KING, J. As. Soc. Beng. 64, ii (1895) 590; K. & V. Bijdr. Booms. Java 5 (1900) 282; HOCHR. Bull. Inst. Bot. Btzig 22 (1905) 43; K. & V. Atlas Booms. Java 1 (1913) t. 124; MERR. En. Born. (1921) 242; RIDL. Fl. Mal. Pen. 1 (1922) 425; BURK. & HENDERS. Gard. Bull. S. S. 3 (1925) 358; HEYNE, Nutt. Pl. (1927) 594; FOXW. Mal. For. Rec. 3 (1927) 125, 2 pl.; HENDERS. Gard. Bull. S. S. 4 (1928) 238; DESCH. Mal. For. Rec. 15, 2 (1954) 422, t. 87, f. 1 (wood); BROWNE, For. Trees Sarawak & Brunei (1955) 282; BACK. & BAKH. f. Fl. Java 2 (1965) 65; WYATT-SMITH & KOCHUM. Mal. For. Rec. 17 (1965) 353; WHITMORE, Tree Fl. Malaya 2 (1973) 306, f. 4; SLEUM. Blumea 26 (1980) 164; DE VOGEL, Seed Dicot. (1980) 378, f. 141 (seedling). — **Fig. 9d–e.**

Tree 10–25 (–40) m; trunk straight, often with knobs, up to 70 (rarely –100) cm ø; crown dense; bark grey to yellowish, shallowly irregularly fissured or cracked; slash outer bark pink, fibrous, turning pale brown. Branches slender. *Leaves* oblong to elliptic- or ovate-oblong, apex shortly subacutely acuminate, base obtuse to rounded, thick-membranaceous to subcoriaceous, deep to pale green when fresh, grey to yellowish olivaceous or brownish in dry specimens, smooth and shining above, practically without pellucid points, (10–) 12–18 (–24) by 4–8 cm; nerves 5–7 pairs (the lowest pair close to the base), curved-ascending, flat above, raised beneath, veins transverse, slightly prominent beneath; petiole slightly swollen distally, 1.5–2 (–2.5) cm. *Cymes* solitary or fascicled, 3–7-flowered, on puberulous peduncle 5–10 mm, which bears a few basal very small caducous bracts; pedicels glabrous, 3–5 mm,

ebracteate and ebracteolate already at anthesis. *Calyx* patelliform, tube rather inconspicuous, 4–5-angular, teeth obscure, c. 3 mm ø. *Petals* ovate-lanceolate, papillose-ciliate, glabrous outside, densely hairy inside, greenish white, reflexed at apex, (6–) 8–10 by 2–3 mm. *Filaments* ciliate at the free top; anthers ovate-oblong, 0.5 mm. *Ovary* deeply 5-furrowed lengthwise; style thick-columnar, as long as ovary; stigma obscurely 5-lobed. *Drupe* obovoid-oblong to almost turbinate, apex truncate and a little impressed, crowned by the remains of calyx, disk and style, the latter forming a hard beak, green, 2–4 by 1.5–2.2 cm; pericarp thin, fleshy; endocarp woody, 0.5 mm.

Distr. Tenasserim to S. Thailand, in *Malesia*: Sumatra (incl. Nias I.), Malay Peninsula, W. Java, Borneo (incl. Natuna Is.), Fig. 10.

Ecol. Lowland rain-forest, also secondary forest, mixed Dipterocarp forest, undulating country, up to c. 600 m, scattered though locally common.



Fig. 10. Range of *Strombosia javanica* BL.

Uses. Young leaves are edible and have the taste of katjang, i.e. various *Leguminosae*. Wood moderately durable, hard and heavy, light yellowish brown, locally used for house constructions and cabinet work.

Vern. *Ki katjang*, *ki kojop*, *S*, *bayam badak*, *bĕlian landak*, *dĕdali*, *ĕntelung*, *madang kalawar*, *sanam sanam*, *M*, *leke-leke*, Nias.

**2. *Strombosia philippinensis*** (BAILL.) ROLFE, J. Bot. 23 (1885) 211; VIDAL, Phan. Cuming. (1885) 23, 102; Rev. Pl. Vasc. Filip. (1886) 86; VALET. Crit. Overz. Olacin. (1886) 87; CERON, Cat. Manila (1892) 45; FOXW. Philip J. Sc. 2 (1907) Bot. 393 (wood); *ibid.* 4 (1909) Bot. 449, t. 22, f. 12 (wood); MERR. En. Philip. 2 (1923) 117; SLEUM. Blumea 26 (1980) 164. — *Lavallee philippinensis* BAILL. Adansonia 2 (1862) 361. — *S. dubia* VIDAL, Sin. Atl. (1883) 20, t. 30, f. D; MERR. Govt. Lab. Publ. Philip. 17 (1904) 15. — *S. minor* ELMER ex MERR. En. Philip. 2 (1923) 117, in obs. pr. syn.; ELMER, Leaf. Philip. Bot. 10 (1939) 3770, descr. angl. — *S. elmeri* SALVOSA, Lexic. Philip. Trees, Bull. For. Prod. Res. Inst. Coll. Laguna 1 (1963) 125.

Tree 5–28 m; trunk up to 30 cm ø. Branchlets slender, glabrous. Leaves subdistichous, ovate-oblong to oblong, rarely lanceolate, apex shortly subacutely acuminate, base cuneate to the petiole, thin-chartaceous, smooth above, finely wrinkled above, green to brownish and rather dull in dry specimens, glabrous, hardly or not pellucid-punctulate, (6–) 8–12 (–16) by (3–) 4–6 (–7.5) cm; nerves 4–5 (–6) pairs curved-ascending, slightly prominent beneath, reticulations obscure; petiole slender, hardly thickened distally, (1–) 1.5–2 cm. Flowers on axillary very short multibracteolate subglobular axes, 5–8 per cluster; pedicels glabrous, c. 1 mm, with 1 or 2 persistent minute scaly bracteoles. Calyx cupular, deeply 5-lobed, glabrous, lobes ovate, ciliate, 0.5 mm. Petals 5, linear-oblong, greenish-white, glabrous outside, hairy at apex inside, 2 by 0.5 mm. Stamens 5; filaments fully adnate to the petals; anthers ovate-oblong, 0.5 mm. Ovary superior, subglobose; style filiform, 1–2 mm. Drupe subglobular, substipitate-attenuate at base for 1–2 mm, apex obtuse, the persistent style base short, c. 1 cm ø; pericarp thin-fleshy, finely tubercled in the dry state as in *S. ceylanica*; endocarp thin-woody.

Distr. *Malesia*: Philippines (Basilan, Catanduanes, Leyte, Luzon, Mindanao, Mindoro, Sibuyan), N. Moluccas (Morotai, Halmahera).

Ecol. Forests at low and medium altitudes, locally common.

Uses. Timber heavy, dull yellowish to pinkish, used for house building.

Vern. *Kamauyán*, Tag., *kamayuán*, Tag., S.L.Bis., *larág*, Ilk., *larák*, Ibn., *samayónan*, Bik.,

*sumayuán*, Tag., *tamahuyán*, Bik., S.L.Bis., *tamayoán*, Neg., Tag., *tamauán*, Tag., *tamayuán*, Ibn., Neg., Tag., *tamayuán*, *tamayuéon*, Bik., Tag.

**3. *Strombosia ceylanica*** GARDN. Calc. J. Nat. Hist. 6 (1845) 350; MIQ. Fl. Ind. Bat. 1, 1 (1856) 787; MAST. Fl. Br. India 1 (1875) 579; VALET. Crit. Overz. Olacin. (1886) 87; K. & V. Bijdr. Booms. Java 5 (1900) 284; HOCHR. Bull. Inst. Bot. Btzig 22 (1905) 43, incl. var. *lucida* (T. & B. ex VALET.) HOCHR., var. *membranacea* (BL.) HOCHR. et var. *sessilis* HOCHR.; Ann. Jard. Bot. Btzig Suppl. 3, 2 (1910) 854; BACK. Schoolfl. Java (1911) 223; KOORD. Exk. Fl. Java 2 (1912) 172; K. & V. Atlas Booms. Java 1 (1913) t. 125; BACK. & BAKH. f. Fl. Java 2 (1965) 64; SLEUM. Blumea 26 (1980) 165. — *Stemonurus? membranaceus* BL. Mus. Bot. Lugd. Bat. 1 (1850) 250. — *S. javanica* auct., non BL.: THWAITES, En. Pl. Ceyl. (1858) 42. — *Sphaerocarya leprosa* DALZ. in Hook. Kew J. Bot. 3 (1851) 34; DALZ. & GIBS. Bombay Fl. (1861) 223. — *Lavallee ceylanica* (GARDN.) BAILL. Adansonia 2 (1862) 361. — *Anacolosia maingayi* MAST. Fl. Br. India 1 (1875) 580; VALET. Crit. Overz. Olacin. (1886) 93. — *S. lucida* T. & B. Cat. Hort. Bog. (1866) 207, nom. nud.; ex VALET. Crit. Overz. Olacin. (1886) 86, pl. 2, f. 18; K. & V. Bijdr. Booms. Java 5 (1900) 286. — *S. membranacea* (BL.) VALET. Crit. Overz. Olacin. (1886) 87; K. & V. Bijdr. Booms. Java 5 (1900) 284. — *S. multiflora* KING, J. As. Soc. Beng. 64, ii (1895) 102; RIDL. Fl. Mal. Pen. 1 (1922) 425; WHITMORE, Gard. Bull. Sing. 26 (1973) 285; Tree Fl. Malaya 2 (1973) 306. — *S. rotundifolia* KING, J. As. Soc. Beng. 64, ii (1895) 103; RIDL. J. Str. Br. R. As. Soc. 33 (1900) 60; Fl. Mal. Pen. 1 (1922) 425; BURK. & HENDERS. Gard. Bull. S. S. 3 (1925) 358; FOXW. Mal. For. Rec. 3 (1927) 123, fig.; HENDERS. Gard. Bull. S. S. 4 (1928) 239; DESCH. Mal. For. Rec. 15, 2 (1954) 423, pl. 87, f. 2 (wood); WYATT-SMITH & KOCHUM. Mal. For. Rec. 17 (1965) 352. — *S. latifolia* STAPP, Kew Bull. (1906) 71; MERR. En. Born. (1921) 242. — *S. rapaneoides* S. MOORE, J. Bot. 62 (1924) Suppl. 22. — *S. maingayi* (MAST.) WHITMORE, Gard. Bull. Sing. 26 (1973) 285; Tree Fl. Malaya 2 (1973) 306; CORNER, Gard. Bull. Sing., Suppl. 1 (1978) 207. — **Fig. 9a–c.**

Shrub or generally tree, 10–20 (–36) m; crown compact; trunk straight, closely branched, occasionally up to 1.2 m ø at base, sometimes buttressed; bark grey to brown, peeling off in scroll-shaped patches. Branches pendulous. Branchlets smooth, glabrous. Leaves elliptic to ovate-oblong, sometimes ovate or suborbicular, apex shortly acuminate, tip acute or bluntish, rarely obtuse-rounded, base cuneate to obtuse or rounded, slightly inequilateral, firmly membranaceous when young, usually subcoriaceous, rarely coriaceous in later stages, glabrous, somewhat shining above when fresh, drying usually dull, green-



ish brown or glaucous-green, conspicuously parchment-like (shagreened) from close wrinkled surface and minutely pustular,  $\pm$  distinctly and densely pelucid-punctulate, considerably varying in size even in the same specimen, 8–15 (–25) by 3–7 (–8.5, –11) cm; nerves (4–) 5–8 (rarely –12) pairs, curved-ascending, obsolete above, not much raised beneath, transverse veins and reticulations rather inconspicuous; petiole a little swollen distally, 4–10 (–17) mm. *Flowers* from small woody warts, (1–) 3–6 (–15) per fascicle; pedicels 1–2 mm; bracts and bracteoles several, rounded, scale-like, reddish, minute. *Calyx* 5-lobed, lobes ovate, obtuse, ciliate. *Petals* 5, oblong or elongately so, greenish white, glabrous outside, hairy except the base inside, tips finally recurved about halfway. *Anthers* ovate. *Ovary* semi-inferior in a conical faintly 5-lobed disk; style filiform, (1–) 2–4 mm. *Drupe* subsessile, pyriform when young, ellipsoid to subglobose with shortly attenuate base when fully developed, apex with the remains of the calyx obtuse-rounded, style base tiny, inconspicuous, 1.6–2 (–2.5) cm; pericarp thin-fleshy, pink to purple, rugose or tuberculate; endocarp thin-woody. *Seed* 1, c. 1.2 cm.

*Distr.* Ceylon and SW. India (Western Ghats from Kanara southwards); in *Malesia*: Sumatra, Malay Peninsula, Anambas Is., West & Central Java, Borneo. Fig. 11.

*Ecol.* In lowland forest and brushwood, mixed Dipterocarp and even secondary forest, often close

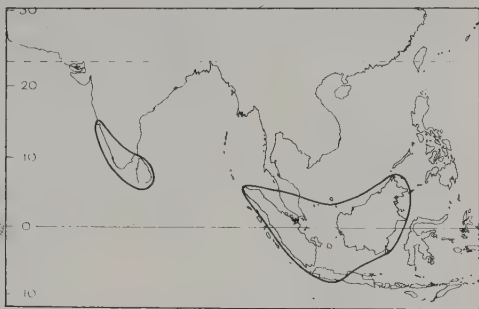


Fig. 11. Range of *Strombosia ceylanica* GARDN.

to the sea, scattered though locally common, on well-drained flat land or lower slopes of ridges, up to c. 800 m.

*Uses.* Wood yellowish brown, hard, heavy, quite durable, used for constructions.

*Vern.* *Pětaling ayer*, M; Borneo: *bělian landak*, Iban, *bungil*, Sampit, *kambau*, Dusun Kinabatangan; Sumatra: *damondjan*, Eastcoast, *mědang huat*, Benkulen.

*Note.* *Strombosia ceylanica* is conceived here in a broad sense including *S. latifolia*, a variant with coriaceous leaves and up to 12 pairs of nerves, which in flower and fruit characters hardly differs from *S. ceylanica* s. str.

## 8. ANACOLOSA

BL. Mus. Bot. Lugd. Bat. 1 (1850) 250, t. 46; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 16 b (1935) 20; Blumea 26 (1980) 146. — Fig. 12–13.

Trees or erect shrubs (none scandent in Mal.). *Leaves* spiral, sometimes subdistichous, penninerved. *Flowers* in sessile (very rarely peduncled) cymes or fascicles, often from bracteolate woody warts or short axes, rarely from trunk or stem, bisexual. *Calyx* cupular, very shortly (5–) 6 (–7)-dentate, or subtruncate, not enlarged after anthesis, subpersistent at base of the mature fruit. *Petals* (5–) 6 (–7) inserted on the margin of the cupular disk, fused in the lower part, fleshy, concave below and including the stamens there, with a bearded keel above the cavity. *Stamens* (5–) 6 (–7); filaments short, flat; anthers broad-ovoid, the cells distant and immersed in the thickened connective, the latter generally with a long-hairy top. *Disk* hypogynous, adnate to the ovary, much accrescent in fruit, 6-denticulate or -furrowed. *Ovary* with its base or for a greater part immersed in the disk, incompletely 2 (–3)-celled below, 1-celled above, with a central basal placenta bearing 2 (–3) unitegmatic ovules pendent from its apex; style short, with a thickened or conical base; stigma very shortly lobed. *Drupe* included by the enlarged disk almost to the top, and tipped by the remains of the style at the

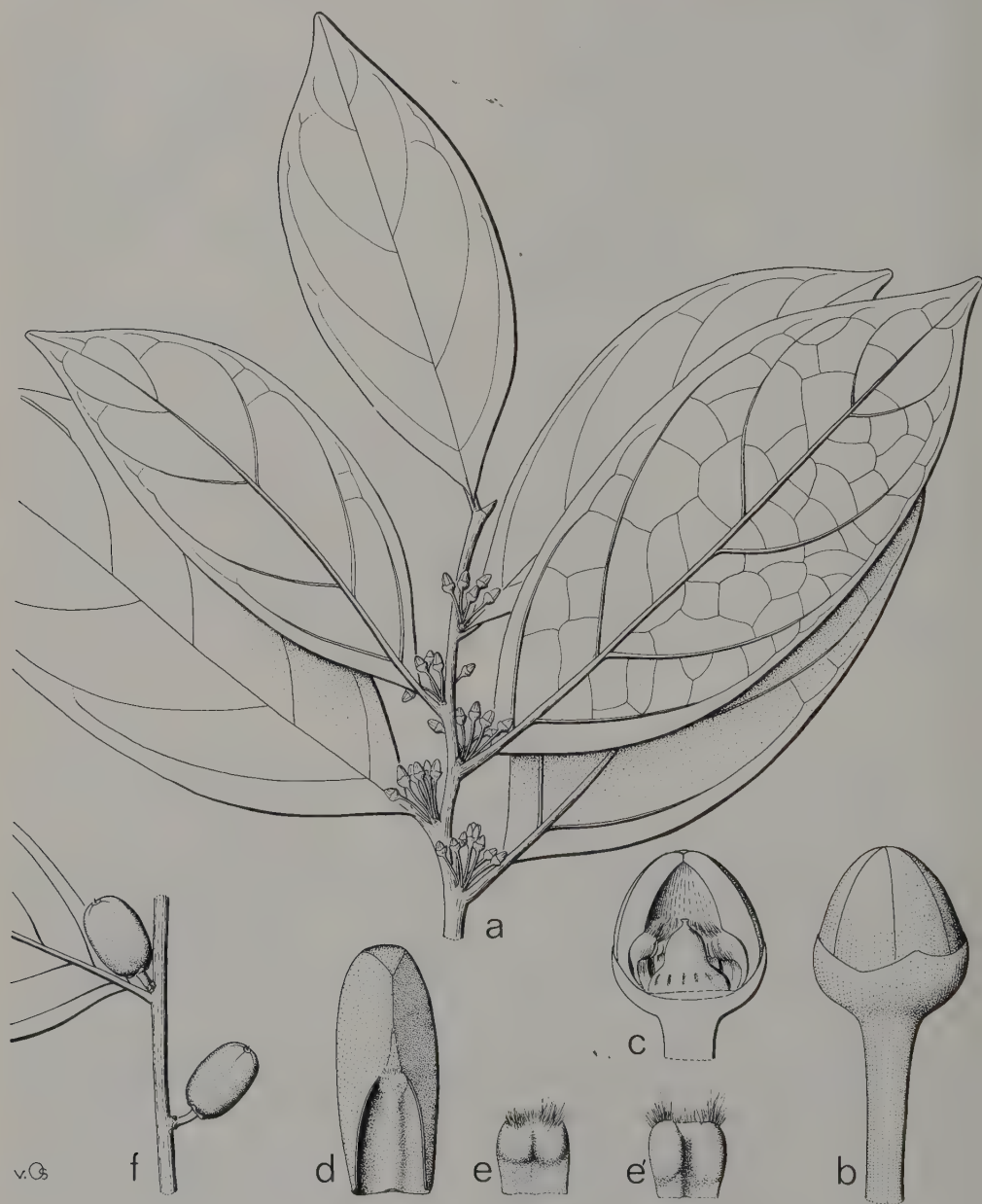


Fig. 12. *Anacolosa frutescens* (Bl.) Bl. *a.* Habit,  $\times 1$ , *b.* flowerbud, *c.* flower, front part of calyx and some petals removed, both  $\times 7$ , *d.* petal inside, *e.* anther, front side, *e'* same from the back, all  $\times 14$ , *f.* fruits,  $\times \frac{1}{2}$  (*a-e* BACKER 22521, *f* SAN 70962).



base subtended by the persistent calyx; pericarp thin-fleshy; endocarp thin-crustaceous. *Seed* 1; embryo minute, at the apex of the fleshy albumen which contains starch and oil.

*Distr.* About 15 *spp.* in the Old World tropics, of which 1 *sp.* in Central Africa, 2 in Madagascar, the rest in S. India (not in Ceylon) to Assam, Burma, Andaman & Nicobar Is., Indochina, Thailand, Malesia and the Pacific; in *Malesia* 3 *spp.*, one of which also in SE. Asia.

*Ecol.* Usually in lowland forest, rarely in montane rain-forest.

## KEY TO THE SPECIES

1. Flowers from the stem ..... 1. *A. cauliflora*
1. Flowers from foliate or defoliate axils of branchlets.
  2. Flowers pedicelled for at least 2 mm. Fruit smooth in the dry state, finally yellow to orange ..... 2. *A. frutescens*
  2. Flowers subsessile (pedicels 0.5–1, rarely up to 2 mm). Fruit smooth or usually markedly tubercled in the dry state, finally cherry red ..... 3. *A. papuana*

**1. *Anacolosa cauliflora* SLEUM.** Blumea 26 (1980) 148.

Treelet 3 m. branchlets glabrous. *Leaves* lanceolate, apex gradually long-attenuate, base cuneate to almost rounded, glabrous, dull, brown and subdensely tubercled on both faces when dry, 20–26 by 4–5.5 cm, midrib impressed above, much prominent beneath, nerves 4–5 pairs, curved-ascending and looping before the edge, obscure above, raised beneath, reticulations obscure; petiole transversely fissured, 5–7 by c. 2 mm. *Inflorescences* from the stem, glomerulate, each with numerous flowers on multi-bracteolate axes 5–10 by 2–3 mm. *Flowers* white, known only in bud. *Calyx* cupular, attenuate towards the base to a kind of stipe, glabrous. *Petals* 6, thickish, glabrous outside, barbate above the anthers inside. *Stamens* 6; anthers barbate apically.

*Distr.* *Malesia*: NW. New Guinea (once found in the Rouffaer R. area).

*Ecol.* In forest, at 250 m.

**2. *Anacolosa frutescens* (BL.) BL.** Mus. Bot. Lugd. Bat. 1 (1850) 251, f. 46; MIQ. Fl. Ind. Bat. 1, 1 (1856) 787; BAILL. Adansonia 3 (1862) 118; VALET. Crit. Overz. Olacin. (1886) 92; O.K. Rev. Gen. Pl. 1 (1891) 111; K. & V. Bijdr. Booms. Java 5 (1900) 291; Ic. Bog. 2 (1904) t. 136; BACK. Schoolfl. Java (1911) 224; KOORD. Exk. Fl. Java 2 (1912) 172; K. & V. Atlas Booms. Java 1 (1913) t. 123; RIDL. Kew Bull. (1931) 34; ANDERSON, Gard. Bull. Sing. 20 (1963) 166; BACK. & BAKH. f. Fl. Java 2 (1965) 65; SLEUM. Blumea 26 (1980) 150. — *Stemonurus frutescens* BL. Bijdr. (1826) 649. — *A. zollingeri* BAILL. Adansonia 3 (1862) 118, cf. *Olacinea ignota*, Z. & M. Syst. Verz. (1846) 25. — *A. heptandra* MAING. ex MAST. Fl. Br. India 1 (1875) 581; VALET. Crit. Overz. Olacin. (1886) 93; KING, J. As. Soc. Beng. 64, ii (1895) 110; RIDL. Fl. Mal. Pen. 1 (1922) 425; WHITMORE, Tree

Fl. Malaya 2 (1973) 300. — *A. arborea* K. & V. Bull. Inst. Bot. Btzg 2 (1899) 9; Bijdr. Booms. Java 5 (1900) 288; KOORD. Nat. Tijd. N. I. 60 (1901) 388; BACK. Schoolfl. Java (1911) 224; KOORD. Exk. Fl. Java 2 (1912) 172; K. & V. Atlas Booms. Java 1 (1913) t. 122. — *A. luzoniensis* MERR. Philip. J. Sc. 4 (1909) Bot. 253; FOXW. l.c. 449 (wood); BROWN, Minor Prod. Philip. For. 1 (1921) 270; WESTER, Philip. Agr. Rev. 14 (1921) t. 35a; Bull. Agr. Philip. Is. 39 (1921) 272; MERR. En. Philip. 2 (1923) 117. — *A. celebica* VALET. in Koord. Minah. (1898) 391; KOORD.-SCHUM. Syst. Verz. 2, 3 (1914) 38. — *Salacia bartlettii* RIDL. Kew Bull. (1938) 239, cf. DING HOU, Fl. Mal. 1, 6 (1964) 420. — **Fig. 12–13.**

Erect shrub or tree, 5–25 (–30) m; trunk occasionally up to 1.4 m ø; outer bark smooth, flaking in large thin pieces, grey to brown, inner one reddish. Branchlets glabrous, grey-corticate below. *Leaves* variable in shape and size, elliptic or elliptic-oblong to lanceolate, apex broadly to narrowly acuminate, tip blunt, base cuneate, slightly inequilateral, chartaceous to coriaceous, shining above when fresh, brownish and rather dull in the dry state, then usually with numerous tiny warts or tubercles on both faces, or mainly so beneath, with numerous fine pellucid points visible against strong light, (6.6–) 7–15 (–22) by (3–) 4–6.5 (–9, –12) cm; nerves (4–) 5–6 pairs, curved-ascending, the lowest pair close to the base, raised beneath, reticulation of transverse veins and veinlets lax, rather inconspicuous; petiole stoutish, 5–7 (–10) mm. *Flowers* on short warts or tubercles (these rarely elongate to short scaly axes), (2–) 5–15 per fascicle; bracts and bracteoles 0; pedicels glabrous or puberulous, 3–5 (–6) mm. *Calyx* cup-shaped, shortly 5–7-lobed or subentire, glabrous or pale rusty-puberulous, c. 3 mm diameter. *Petals* (5–) 6 (–7), ovate-lanceolate, connate about halfway, thickish, glabrous or rarely puberulous outside, bar-



Fig. 13. *Anacolosa frutescens* (BL.) BL. Twig with fruits,  $\pm$  nat. size; Sarawak (Photogr. DING HOU 380).

bate in the upper free cristate and finally recurved part inside, green-white, 2–3 (rarely –4) by 1–1.5 mm. *Stamens* 5–7; filaments flat; anthers barbate apically. *Ovary* surrounded by the slightly 12-grooved disk; style short-conical; stigma minute, shortly lobed. *Drupe* obovoid-ellipsoid to oblong-oid, seated on the persistent non-acrescent calyx, apex truncate and slightly 6-sulcate, the persistent style base very short, at maturity yellow to orange, (1.5–) 1.8–2 (–2.5) by (1.2–) 1.5–2 cm, on stout pedicel 6–8 by 1.5 mm; pericarp thin-fleshy; endocarp thin-crustaceous. *Seed* 1; albumen copious.

*Distr.* Burma, Andaman & Nicobar Is., E. Thailand; in *Malesia*: Sumatra (Eastcoast, Palembang), Malay Peninsula, West & Central Java, Borneo, NE. Celebes (Minahasa), Moluccas (Sula Is.: Taliabu), Philippines (Luzon, Mindoro, Panay, Masbate,

Mindanao). Fig. 14.

*Ecol.* In lowland and submontane forest, mixed Dipterocarp forest, along stream in kerangas forest, sometimes in peat swamp forest (Borneo), also in secondary forest, occasionally on limestone, scattered though locally frequent, from sea-level up to 700 (rarely –1400) m.

*Uses.* Wood pale reddish brown, hard and heavy, used for house posts, but said to be not durable.

*Vern.* W. Java: *kopi gunung, tangki leuweung*, S; Borneo: *bĕlian landak*, Iban; Philippines: *aluloi, gálo*, Tag., *mataboto*, S.L.Bis., *yu-pa*, Gad.

**3. *Anacolosa papuana* SCHELLENB. Bot. Jahrb. 58 (1923) 157; SLEUM. Blumea 26 (1980) 148.**

Small tree, occasionally up to 15 m; trunk up to 10 cm  $\varnothing$ ; bark smooth, light brown, with shallow longitudinal fissures. Branchlets glabrous, minutely lenticellate. *Leaves* oblong to oblong-elliptic, apex shortly acuminate, tip acute or bluntish, base cuneate, firmly membranaceous to subcoriaceous, dark green above, lighter below when fresh, becoming dull and brown in the dry state, glabrous, more or less densely and finely tubercled and wrinkled on both faces though mainly beneath in dry specimens, pellucid-punctulate against strong light, variable in size even in the same specimen, (8–) 10–26 by (3–) 4–7 (–10) cm; nerves 5–6 pairs, curved-ascending, raised beneath only, reticulations obscure; petiole 0.5–1 (–1.3) cm. *Flowers* 2–8 per sessile cluster, the latter on small woody scaly warts or tubercles, or on top of cylindrical woody axes (2–3, rarely –6 mm); pedicels 0.5–1 (rarely –2) mm. *Calyx* cupular to almost patelliform, entire, c. 3 mm  $\varnothing$ , attenuate at base towards to pedicel. *Petals* (5–) 6 (–7), lanceolate,

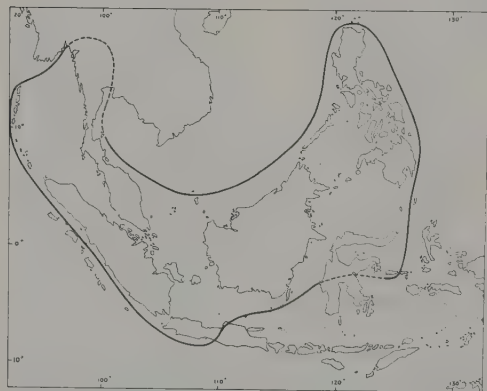


Fig. 14. Range of *Anacolosa frutescens* (BL.) BL.



acute, fused in the lower part, thickish, white or cream, bearded at base of free part, glabrous below, 2–3 (rarely 4) by c. 1 mm. *Stamens* 5–7; filaments flat, glabrous; anthers bearded distally. *Disk* cupular, flattish. *Ovary* ovoid, glabrous; style very short. *Drupe* subglobose to slightly obovoid, the apex obtuse-rounded, rarely subtruncate, the remains of the style very short, smooth or usually shallowly tubercled in the dry state, yellowish to orange initially, finally deep cherry-red, (1.5–) 1.8–2.5 (sometimes

–3.5) by 1.3–2 (–2.5) cm, on stoutish peduncle up to 5 mm; pericarp thin-fleshy; endocarp woody, smooth or warted, 0.5–1 mm. *Seed* 1.

*Distr.* *Malesia*: New Guinea, Solomon Is. (Bougainville to San Cristobal).

*Ecol.* Understorey tree in lowland to mid-mountain rain-forest, also advanced secondary forest, rarely in flood plain or swamp forest, from sea-level up to c. 1675 m, locally common.

## 9. SCHOEPIA

SCHREB. Gen. (1789) 129; ENGL. in E. & P. Nat. Pfl. Fam. 3, 1 (1894) 233; Nachtr. 1 (1897) 145; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 30; STEEN. Reinwardtia 1 (1952) 467; SLEUM. Blumea 26 (1980) 161. — *Schoepfiopsis* MIERS, J. Linn. Soc. Bot. 17 (1878) 75. — **Fig. 15.**

Trees or shrubs, often root-parasites. *Leaves* spiral, penninerved. *Flowers* bisexual, fragrant, white or yellow, often heterostyled, in short racemes or corymbs; base of rachis with small imbricate scaly perulae (Mal.). Bract and bracteoles united at apex of pedicel into a small, acutely 3-lobed, persistent epicalyx. *Calyx* inconspicuous, *i.e.* connate with the cup-shaped truncate flower-axis. *Petals* 4–5 (–6), inserted on the edge of the flower axis, connate in the lower 1/2–2/3 to a tubular-campanulate corolla, free and revolute above, with a tuft of hairs inside the tube behind each anther. *Stamens* 4–5 (–6), epipetalous, the slender filaments adnate to the corolla tube for almost their full length, free at apex; anthers free, 2-celled, attached below the middle. *Disk* epigynous, annular, fleshy. Upper half of the *ovary* superior, included by the disk, lower half within the flower axis, 3-celled below, 1-celled above; style slender; stigma 3-lobed; placenta central, with 3 ategmic ovules pending from its apex. *Fruit* drupaceous, subtended at base by the persistent epicalyx, crowned by the remains of calyx, disk and corolla; epicarp (which originates from the somewhat accrescent flower-axis) thin, fleshy; endocarp crustaceous to pergamaceous, striate lengthwise. *Seed* 1; embryo very small at the apex of the fleshy albumen which contains oily substances.

*Distr.* About 24 *spp.*, of which c. 20 in (sub)tropical America, and c. 4 in SE. Asia, one of which in *Malesia* (N. Sumatra).

*Ecol.* In lowland to montane, even mossy forest.

**1. *Schoepfia fragrans* WALL.** in ROXB. Fl. Ind. ed. Wall. & Carey 2 (1824) 188; MAST. Fl. Br. India 1 (1875) 581, excl. GRIFFITH t. 629; STEEN. Reinwardtia 1 (1952) 470, f. 1; SLEUM. Blumea 26 (1980) 162. — *Schoepfiopsis fragrans* (WALL. in ROXB.) MIERS, J. Linn. Soc. Bot. 17 (1878) 76. — **Fig. 15.**

Glabrous shrub or small tree, (1–) 3–5 (–12) m; bark thick, corky, whitish grey or pale brown, with fine horizontal fissures. Branchlets angular. *Leaves*

elliptic-oblong to lanceolate, apex acuminate, base acute, subinequilateral, chartaceous to subcoriaceous (rarely coriaceous at higher altitudes), dark green above, paler beneath when fresh, often tubercled, 5–9 (–12) by (1.2–) 3–5 (–6) cm; nerves 5–7 (–9) pairs, inarching, inconspicuous above, a little raised beneath; petiole slender, 4–6 (–7) mm. *Racemes* solitary, 3–7 (–10)-flowered, 2.5–3 (–4) cm; peduncle provided at base with several persistent small



Fig. 15. *Schoepfia fragrans* WALL. *a.* Habit,  $\times 1$ , *b.* flower, opened, supported by the 3 bracts at base,  $\times 2$  (VAN STEENIS 9719).

perular bracts; pedicels slender, (5-) 8-10 (-12) mm, distally with a cupule formed by 1 bract and 2 bracteoles, 0.5 mm. *Calyx* obconical, edge truncate, adherent to the ovary and accrescent in fruit. *Corolla* tubular, fleshy, whitish or pinkish to yellowish, or even sulphur-yellow, with a scent of jasmine, tube 0.8-1 cm long, 4-5 mm  $\varnothing$ , grooved at base where it is agglutinated (or connate) around the ovary; lobes oblong, subacute, 4-5 mm, with a tuft of hairs at their inner base above the insertion of the anthers.

*Stamens* (4) 5; filaments cohering to corolla tube; anthers ovate, subbilobed, free in the throat. Disk epigynous, pulvinate. *Ovary* half-superior, turbinate, 5-6 mm long; style as long as or shorter than the corolla tube; stigma generally 3-lobed. *Drupe* ellipsoid-oblongoid, whitish or cream to yellow, (0.7-) 1-1.2 cm long, 0.7-0.8 mm  $\varnothing$ , crowned by the disk; pericarp succulent when ripe, 1-2 mm thick; endocarp thin-crustaceous, striate lengthwise. *Seed* 1, white, conforming with the endocarp.



Distr. Nepal, Bhutan, E. Bengal, Assam, Burma, SW. China, Thailand, Indochina; in *Malesia*: N. Sumatra (Atjeh: Gajo Lands).

Ecol. In primary montane forest or forest borders, also in mossy forest, (600–) 1400–2500 (–3000) m.

#### Excluded

Several genera formerly accommodated in a larger family concept '*Olacineae*' are excluded and treated under *Icacinaceae* (see Fl. Males. I, 7, 1971, 1–87) or *Opiliaceae* (this volume, pp. 31–52). The present list is restricted to those genera and some species which have in the past been ascribed to *Olacineae* but which belong to different families.

*Bracea* KING, J. As. Soc. Beng. 64, ii (1898) 101 is according to STAPP & KING, Ic. Pl. 7 (1901) t. 2690 = *Sarcosperma* (*Sarcospermataceae*).

*Ctenolophon* OLIV. Trans. Linn. Soc. 28 (1873) 516, t. 43 belongs according to WINKLER in E. & P. Nat. Pfl. Fam. ed. 2, 19a (1931) 122 to *Linaceae*.

*Erythrophalum triandrum* QUIS. & MERR. Philip. J. Sc. 37 (1928) 143 = *Alsomitra macrocarpa* (BL.) ROEM. (*Cucurbitaceae*), *fide* Kew.

*Fissipetalum* MERR. J. Str. Br. R. As. Soc. 85 (1922) 168 is according to AIRY SHAW, Kew Bull. (1947) 22 = *Ericybe* ROXB. (*Convolvulaceae*).

*Pteleocarpa* OLIV. Trans. Linn. Soc. 28 (1873) 515 has, with some doubt, been accommodated in *Boraginaceae*.

*Strombosia? philippinensis* [non (BAILL.) ROLFE] LAM & HOLTHUIS, Blumea 5 (1942) 178, based on LAM 3175 from Talaud Is., is identified by BAKHUIZEN *f.* & VAN STEENIS as *Celtis paniculata* (ENDL.) PLANCH. (*Ulmaceae*).

*Worcesterianthus* MERR. Philip. J. Sc. 9 (1914) Bot. 288; *ibid.* 10 (1915) Bot. 270 is according to VAN STEENIS, Acta Bot. Neerl. 4 (1955) 478 = *Microdesmis* HOOK. *f.* (*Euphorbiaceae* or *Pandaceae* respectively).





## OPILIACEAE (P. Hiepko, Berlin)

Small evergreen trees, shrubs or lianas; two genera (*Cansjera* and *Opilia*) are known to be root-parasites. *Leaves* distichous, simple, usually extremely variable in form and size, entire, exstipulate, pinnately veined; dried leaves mostly finely tubercled by cystoliths located in the mesophyll. *Inflorescences* axillary or cauliflorous, panicle-like, racemose, umbellate (in Africa) or spicate; bracts narrowly ovate or scale-like, in *Opilia* peltate, often early caducous. *Flowers* small, (3–) 4–5 (–6)-merous, mainly bisexual, sometimes unisexual and plants then dioecious (*Gjellerupia*, *Melientha*, and *Agonandra*) or gynodioecious (*Champereia*). Perianth with valvate, free or sometimes partly united tepals (in ♀ flowers of *Gjellerupia* wanting). *Stamens* as many as and opposite to the tepals (in ♀ flowers only small staminodes); anthers introrse, 2-celled, longitudinally dehiscent. *Disk* intrastaminal, lobed (lobes alternating with the stamens), annular, or cupular. *Ovary* superior, 1-celled; style short or none, stigma entire or shallowly lobed. *Ovule* 1, pendulous from the apex of a central placenta, anatropous, unitegmic and tenuinucellar. *Fruit* drupaceous, pericarp rather thin, mesocarp ± fleshy-juicy, endocarp woody or crustaceous. *Seed* large, conform to the drupe, without testa; hilum basal, often in a funnel-shaped cavity. *Embryo* terete, embedded in rich, oily endosperm, nearly as long as the seed or shorter, with 3–4 linear cotyledons, radicle often very short.

**Distribution.** There are 9 genera with about 30 *spp.*, widespread in the tropics. *Rhopalopilia* is restricted to Africa and Madagascar, *Agonandra* to South and Central America. In Malesia: 7 genera, 5 of these only known from the eastern Old World (1 endemic: *Gjellerupia* in New Guinea); *Opilia* and *Urobotrya* occur also in tropical Africa.

**Ecology.** Some species of *Opiliaceae* occur as undergrowth in evergreen forest, primary and secondary, e.g. *Lepionurus sylvestris* is in Java an indicator of everwet climate [cf. VAN STEENIS in Back. & Bakh. f. Fl. Java 2, 1965, (70)]. Other species tolerate or prefer a more seasonal climate and are constituents of deciduous forest. *Cansjera* and *Opilia* often occur in beach forest.

As to the altitude the species of *Opiliaceae* are usually found at low and medium altitude below 1000 m, only some species ascend with several collections up to 1600 or even 2000 m (*Lepionurus* in Sumatra).

Some species are mainly growing on sandy soil, others are more often found on limestone.

**Habit.** Most species are small trees of about 3–8 m, sometimes gregariously growing (*Urobotrya* spp.) or tiny shrubs (*Lepionurus* often less than 1 m high); only *Champereia* and *Melientha* can attain sizes of more than 10 m. The lianas (*Cansjera* and *Opilia*) are climbing up to 30 m, but they are often recorded as erect shrubs, too. The stem of a young *Cansjera rheedii* is growing in an inclined position and the branches are spreading (cf. HIEPKO & WEBER, Willdenowia 8, 1978, 354, f. 1); if there is no tree for climbing up it becomes an erect shrub.

**Pollination.** The flowers of all species of this family possess nectar-secreting disks; some flowers are fragrant. They are evidently entomophilous. The inflorescences of *Champereia manillana* are often visited by ants.

**Dispersal.** The fruits of *Opiliaceae* are drupaceous and vary in size from less than 1 cm long (*Champereia*) to 4 cm (*Melientha*). For *Champereia* it is reported that the fruits are eaten by birds.

**Galls.** Galled fruits (or flowers?), in form and size like peas, have been observed in some specimens of *Opilia amentacea* (in N. Borneo, Philippines, and New Guinea).

**Parasitism.** Root-parasitism has been proved to occur in *Cansjera leptostachya*, *C. rheedii* and *Opilia amentacea* (see under these species). According to HIEPKO & WEBER (*l.c.*), *Cansjera rheedii*

forms 4 morphologically different types of haustoria. The largest type of haustoria is formed in the root hair zone and may grow up to 1 cm or more in diameter. Selfparasitism is common in this species, and it was shown that it is also mycotrophic (cf. WEBER, *Naturwissenschaften* 64, 1977, 640 f.).

**Morphology.** The panicle-like inflorescences of *Champereia* and *Melientha* are irregularly branched (fig. 2, 5), the flowers are pedicelled or sessile. In the racemose inflorescences of some genera the pedicelled flowers are arranged in ternate groups (in the axil of each bract) along the rachis, showing that these inflorescences are not genuine racemes but more complex types of inflorescences. Occurrence of bracteoles in some species of *Urobotrya* stresses this opinion.

The perianth of *Opiliaceae* was often described as composed of a 'minute and inconspicuous' calyx and  $\pm$  free petals. Other authors use these terms only for the description of *Opilia*, whereas the flowers of the other genera are called monochlamydeous (e.g. BACK. & BAKH. f. *Fl. Java* 2, 1965, 66). Since the flowers of *Opilia* show solely a slightly cupuliform torus which hardly can be called calyx, I use the terms perianth and tepals for the entire family.

**Anatomy. Wood.** Most *Opiliaceae* are wood anatomically rather homogeneous. The light coloured wood shows often faint to distinct growth rings. The vessels are predominantly solitary, but up to 40–80% in radial multiples and tangential groups in *Lepionurus* and *Urobotrya latissquama*. The shrubby species show small vessels, the lianas have vessel diameters up to 200  $\mu$ m. Fibres are often thick-walled, with minutely bordered pits in *Gjellerupia* and *Lepionurus*, and bordered pits up to 4–6  $\mu$ m in the other genera. The rays are 2–6-seriate mingled with few uniseriates; ray cells are weakly procumbent and square/upright, except in *Agonandra*, *Opilia*, *Champereia*, and *Melientha*, where the rays are composed of clearly procumbent cells. With the exception of *Agonandra*, all genera show cystoliths of calcium carbonate in enlarged ray cells. The presence or absence of stalks and the size and shape of the cystoliths seem to have diagnostic value. Parenchyma strands are apotracheal, diffuse or diffuse-inaggregate.

**Leaves.** Cystoliths occur in all representatives, commonly in pairs of clusters in enlarged mesophyll cells or ray cells of the vascular tissue. Size, shape and refractive properties seem to be taxonomically relevant. Within the family, uniseriate and branched hairs (the last mentioned in species of *Opilia*, *Rhopalopilia* and *Cansjera*) are found. They may cover leaf surfaces, or may be restricted to midrib and veins, or are lacking. Stomata are paracytic with two to several subsidiary cells. Some variation in differentiation of the mesophyll is found: either a homogeneous tissue of cubic cells, or two layers of palisade parenchyma and spongy parenchyma, with or without a hypodermis.

Both wood and leaf characters point to a very close relationship between *Champereia* and *Melientha*. Of the other Malesian taxa, *Gjellerupia*, *Lepionurus*, and *Urobotrya* are very similar. *Opilia* and *Cansjera*, as well as the African *Rhopalopilia* and the neotropical *Agonandra*, seem to have a slightly isolated position.

**Literature:** DESCH, *Mal. For. Rec.* 15<sup>2</sup> (1954) 431; EDELHOFF, *Bot. Jahrb.* 8 (1887) 100–153; KOEK-NOORMAN & VAN RIJCKEVORSEL, *Willdenowia* 13 (1983) 147–174; METCALFE & CHALK, *Anat. Dicot.* Oxford (1950) 379–381; REED, *Mem. Soc. Brot.* 10 (1955) 29–79; SOLEREDER, *Syst. Anat. Dicot.* Stuttgart (1899) 227–237, 829–830; *ibid.* (1908) 81–83. — J. KOEK-NOORMAN.

**Embryology.** Detailed embryological investigations on members of this family are very rare. Only in *Cansjera rheedii* (SWAMY, 1960) and *Opilia amentacea* (SHAMANNA, 1955; SWAMY & RAO, 1963) the male and female gametophyte have been studied. In the tetrasporangiate anther a glandular tapetum with 2–4-nucleate cells is developed. The pollen grains are 2-celled when shed.

The anatropous ovule is unitegmis and has a much reduced nucellus. The nucellar tissue and the integument collapse in later stages of ovular development (therefore the ovules often have been described as ategmic). The chalazal megaspore of the linear tetrad develops into a *Polygonum* type embryo sac. A chalazal caecum grows down into the solid part of the gynoeceum and so the embryo sac becomes U-shaped at maturity. The endosperm is cellular. Its chalazal chamber grows towards the base of the ovary forming a 1-nucleate haustorium which in *Opilia amentacea*



reaches the pedicel of the flower. In *Cansjera rheedii* the haustorium is branched and secondary haustoria are developed. The embryogeny has not yet been studied.

*Literature:* DAVIS, Embryol. Angiosp. (1966) 193 f.; FAGERLIND, Svensk Bot. Tidskr. 42 (1948) 195–229; SHAMANNA, Curr. Sci. 24 (1955) 165–167; SWAMY, Phytomorphology 10 (1960) 397–409; SWAMY & RAO, *ibid.* 13 (1963) 423–428.

*Palynology.* The first detailed palynological survey of *Opiliaceae* (together with the other families of *Olacales*) was given by REED (1955). The results of my own studies during the last years have not yet been published.

The pollen grains of *Opiliaceae* (in Mal.) are always simple, spherical or suboblate (*Gjellerupia*, *Lepionurus*), and mostly distinctly tricolporate. The ectoaperture is a furrow bordered by a smooth margin (*Urobotrya* and *Opilia*). In *Lepionurus* the ectoapertures are very short and distinct. If the pollen is reticulate, the meshes are interrupted by the colpi (*Champereia*, *Gjellerupia*, *Melientha*, and *Urobotrya*) or closed by a murus (*Lepionurus*).

The apertural membrane is granulate only on the endoaperture in *Cansjera*, *Champereia*, and *Gjellerupia*, but on the whole surface of the furrow in *Opilia* and *Urobotrya*.

The ectexine consists of tectum, infratectal layer and foot-layer. The tectum varies in thickness and may be smooth, perforate, echinulate (*Agonandra*) or reticulate, sometimes with crested muri (*Champereia*, *Lepionurus* and *Melientha*), while in some genera the meshes are not closed (e.g. *Gjellerupia*). The infratectal layer is columellate, except in *Cansjera* in which it is granular. The foot-layer is often sculptured on the inner side of the apertural margin. Endexine is generally present.

The pollen of *Opiliaceae* is similar to the pollen of *Olacaceae* (LOBREAU-CALLEN, 1980) where we also find many suboblate grains. It also resembles pollen of *Icacinaceae*. The pollen grains of *Cansjera* are similar to those of certain genera of *Santalaceae* (*Scleropyrum*, *Pyrularia*, etc.) and to those of *Octoknemaceae*. These families have an endosculptate foot-layer and an ornamented apertural membrane (except many *Icacinaceae*).

*Literature:* ERDTMAN, Pollen morphology and plant taxonomy, Angiosperms (1952) 298–299; LOBREAU-CALLEN, Adansonia sér. 2, 20 (1980) 29–89; REED, Mem. Soc. Brot. 10 (1955) 29–79. — D. LOBREAU-CALLEN.

*Chromosomes.* Chromosome numbers of 3 spp. have been recorded, two of these species occur in Malesia: *Lepionurus sylvestris* ( $n = 10$ ) and *Opilia amentacea* (= *O. celtidifolia*,  $2n = 20$ , African material counted). The neotropical *Agonandra racemosa* has the same chromosome number ( $n = 10$ ).

*Literature:* KHOSLA, Nucleus 21 (1978) 211–218; MANGENOT & MANGENOT, Bull. Jard. Bot. Brux. 28 (1958) 323; SEAVEY, Taxon 24 (1975) 671.

*Phytochemistry.* HEGNAUER (1969) stressed the paucity of phytochemical information on *Opiliaceae*. The most interesting feature then known was the presence of acetylenic fatty acids in the lipids of roots, stem and leaves of *Cansjera leptostachya* BTH. This connects *Opiliaceae* biochemically with *Olacaceae* and *Santalaceae*. In the meantime phytochemical screenings of some medicinally used African *Opiliaceous* plants demonstrated the presence of saponins in two Madagascan species of *Rhopalopilia* (DEBRAY c.s., 1971), in *Rhopalopilia pallens* PIERRE (BOUQUET, 1970) and in *Opilia celtidifolia* (GUILL. & PERR.) ENDL. (HAERDI, 1964, l.c. sub 'Uses'; BOUQUET & DEBRAY, 1974; SHIHATA c.s., 1977). Alkaloid-like substances were also detected in the Madagascan *Rhopalopilia* spp., in *Rhopalopilia pallens* and in *Opilia celtidifolia*, but confirmation of the presence of true alkaloids by isolation and characterization is still lacking. Saponins of the bark of *Opilia celtidifolia* have triterpenic sapogenins, i.e. oleanolic acid and hederagenin, according to SHIHATA c.s. (1977). This is in line with the saponins of African *Olacaceae* which have recently been shown to have mainly oleanolic acid and hederagenin as sapogenins.

*Literature:* BOUQUET, Plantes méd. Congo-Brazzaville, Thèse (Pharm.), Univ. Paris (1970) 37; BOUQUET & DEBRAY, Plantes méd. Côte d'Ivoire, Trav. Doc. O.R.S.T.O.M. no. 32, Paris (1974) 133; DEBRAY c.s. Contr. inventaire plantes méd. Madagascar, Trav. Doc. O.R.S.T.O.M. no. 8,

Paris (1971) 31; HEGNAUER, *Chemotaxonomie der Pflanzen* 5 (1969) 248–249; SHIHATA c.s. *Planta Medica* 31 (1977) 60–67. — R. HEGNAUER.

**Taxonomy.** Before VALETON (1886) established the *Opiliaceae* as a distinct family the genera of this group have been placed by different authors in several other families. BENTHAM & HOOKER (1862) e.g. treated the tribe *Opilieae* (*Lepionurus*, *Cansjera*, *Opilia*, and *Agonandra*) as a part of their *Olcaceae*, whereas *Champereia* was a member of their *Santalaceae* (B. & H., 1883). In the treatment of BAILLON (1892) the *Opilieae* (including *Opilia*, *Lepionurus*, *Champereia*, *Melientha*, *Agonandra*, and *Cansjera*) made part of the family *Loranthaceae*, which included also the *Olcaceae*, *Santaleae* and several other groups today mostly considered to form distinct families. ENGLER (1889) treated *Champereia* also as a genus of *Santalaceae*; the other genera of our *Opiliaceae* were placed in two different tribes of the family *Olcaceae*, namely the *Opilieae* (*Opilia*, *Cansjera*, and *Lepionurus*) and *Agonandreae* (*Agonandra*).

In 1897 ENGLER accepted the family *Opiliaceae* as established by VALETON (*l.c.*) and transferred *Champereia* according to the treatment of VALETON from *Santalaceae* to the tribe *Opilieae* of this family. In the classification of SLEUMER (1935) the same two tribes are set down: *Opilieae* and *Agonandreae*. The second tribe is composed of the genera *Gjellerupia* and *Agonandra*. Since *Gjellerupia* is, with respect to morphological, anatomical, and palynological characters, obviously more closely allied to *Urobutrya* and *Lepionurus* it has also to be included in the *Opilieae*.

Most present-day authors consider *Opiliaceae* in our circumscription as a distinct family placed along with *Olcaceae* and *Santalaceae* in the order *Santalales* (or *Olcaceles*). THORNE (1981) very recently included this family in the rank of a subfamily in his *Olcaceae*.

**Literature:** BAILLON, *Hist. Pl.* 11 (1892) 456–458; BENTHAM & HOOKER, *Gen. Pl.* 1 (1862) 349; *ibid.* 3 (1883) 231; ENGLER in E. & P. *Nat. Pfl. Fam.* 3, 1 (1889) 214, 240–241; *ibid.* Nachtr. 1 (1897) 143; SLEUMER in E. & P. *Nat. Pfl. Fam.* ed. 2, 16b (1935) 33–41, 339; THORNE in Young & Seigler, *Phytochemistry and angiosperm phylogeny* (1981); VALETON, *Crit. Overz. Olacin.* (1886) 136–161.

**Uses.** Young leaves and inflorescences (incl. young fruits) of *Champereia manillana* and *Melientha suavis* are frequently used as a vegetable. The fruits (juicy mesocarp) of some species are also eaten locally and occasionally: *Cansjera leptostachya* (Northern Australia), *Champereia manillana* (in many parts of the range), *Melientha suavis* (in Thailand), and *Opilia* spp. (in Northern Australia and different parts of Africa).

Some species are used in local folk medicine (pounded or as a decoction): *Champereia manillana* (leaves and roots applied for ulcers, rheumatism, headache, and stomachache); *Lepionurus sylvestris* (roots or whole plant applied for fever or headache); *Opilia amentacea* (roots and/or leaves are in Africa applied for fever, headache, or intestinal parasites; in W. Africa the plant is said to have a purgative, diuretic, and abortive action); *Urobutrya siamensis* (in Thailand used for a medicine against intestinal parasites, in large amount a deadly poison).

The wood of *Melientha suavis* is often used for charcoal in Thailand.

**Literature:** BURKILL, *Dict. Econ. Prod. Mal. Pen.* (1935) 526, 1353; DRUET & COMEAU, *Ann. Univ. Abidjan, sér. C*, 14 (1978) 57–67; DUNLOP c.s. *N. Territ. Bot. Bull.* 1 (1976) 59; HAERDI, *Acta Tropica*, Suppl. 8 (1964) 109; HIEPKO, *Willdenowia* 9 (1979) 13–56; IRVINE, *Woody plants of Ghana* (1961) 474; WORSLEY, *Acta Ethnographica* 10 (1961) 153–190.

#### KEY TO THE GENERA

1. Inflorescence a panicle or panicle-like, in axils of leaves, often also on older branches and on the main trunk.
2. Shrub or small tree, polygamous (gynodioecious). Flowers distinctly pedicelled. Drupe ellipsoid, 8–16 mm long. . . . . **1. *Champereia***
2. Small tree. Flowers unisexual, sessile, the female flowers often with a very short pedicel, elongated in fruiting state. Drupe ellipsoid, 2.3–4 cm long. . . . . **2. *Melientha***

1. Inflorescence a raceme or spike, in axils of leaves, rarely on older branches or on the trunk.
3. Flowers in racemes, mostly 3 per bract. Bracts broadly ovate to ovate or cordate, caducous before anthesis. Tepals free or united at the base only (rarely female flowers without perianth).
4. Shrub or small tree. Rachis of raceme glabrous or puberulous, pedicels glabrous. Bracts basally attached, not peltate. Drupe usually less than 1.5 cm long.
5. Flowers bisexual. Raceme at least 2.5 cm, mostly longer. Drupe ellipsoid.
6. Tepals free, recurved. Stamens exceeding the perianth. Disk annular. Drupe 8–16 mm
3. **Urobotrya**
6. Tepals united at base, tube cupular, lobes spreading. Stamens not exceeding the perianth. Disk cupular with irregularly lobed margin. Drupe 9–16 mm long, resting on the thickened disk 4. **Lepionurus**
5. Plant dioecious. Raceme 1–2 cm long. Female flowers without perianth, male flowers with free tepals. Drupe ± orbicular. 5. **Gjellerupia**
4. Liana, sometimes an erect shrub. Rachis of raceme and pedicels densely covered with brownish hairs. Bracts peltate. Drupe ellipsoid, 1.5–3 cm long 6. **Opilia**
3. Flowers in spikes, each flower in the axil of a small (c. 1 mm long) persistent bract. Tepals united, tube urceolate, lobes shorter than the tube 7. **Cansjera**

### 1. CHAMPEREIA

GRIFF. Calc. J. Nat. Hist. 4 (1843) 237; Flora 27, 2 (1844) 436; Not. Pl. As. 4 (1854) 362; Ic. Pl. As. 4 (1854) t. 537 ('*Champereya*'); B. & H. Gen. Pl. 3 (1883) 231; VALET. Crit. Overz. Olacin. (1886) 150; ENGL. in E. & P. Nat. Pfl. Fam. 3, 1 (1889) 214 (*sub Santalaceae*); BOERL. Handl. 1 (1890) 210; BAILL. Hist. Pl. 11 (1892) 457 (*sub Loranthaceae*); ENGL. in E. & P. Nat. Pfl. Fam. Nachtr. 1 (1897) 143 (*sub Opiliaceae*); SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 37; HIEPKO, Willdenowia 9 (1979) 14. — *Malulucban* BLCO, Fl. Filip. (1837) 188, *nom. illeg.* — *Opilia sect. Opiliastrum* BAILL. Adansonia 3 (1862) 123. — *Govantesia* LLANOS, Rev. Progr. Cienc. 15 (1865) 191. — *Nallogia* BAILL. Bull. Soc. Linn. Paris 2 (1892) 985; Hist. Pl. 11 (1892) 478. — **Fig. 1, 2, 5b.**

Shrubs or small trees; branchlets glabrous. *Leaves* coriaceous-fleshy. Plants polygamous with ♀ or ♂ flowers in panicles. Panicles axillary, often also on older branches or on the main trunk. *Inflorescences* with ♀ flowers widely branched; ♂ inflorescences more dense with stout branches, rachises sometimes finely puberulous. *Flowers* 5- (sometimes 4- or 6-)merous, with pedicels, solitary or fascicled along the branches of the inflorescence; bracts minute, fugacious. — ♀ Flowers: tepals reflexed; filaments filiform; ovary small, conical, half immersed in the fleshy, annular disk; stigma sessile. — ♂ Flowers: tepals adjacent to the ovary; stamens rudimentary; disk lobed. *Drupe* shortly pedicelled, ellipsoid; pericarp thin, 0.8–1.2 mm thick, mesocarp fleshy, endocarp woody. *Embryo* nearly as long as the seed, radicle small, with 3 long cotyledons.

Distr. One variable species: Andamans, Burma, Thailand, Vietnam, Taiwan, and *Malesia*. Fig. 3.

Ecol. Open evergreen forest and dry monsoon forest, from lowland up to c. 1600 m, mostly below 900 m.

1. *Champereia manillana* (BL.) MERR. Philip. J. Sc. 7 (1912) Bot. 233; Fl. Manila (1912) 185; Philip. J. Sc. 11 (1916) Bot. 268; Sp. Blanc. (1918) 133; En. Philip. 2 (1923) 116; KOORD. Exk. Fl. Java 4 (1925)

580, f. 862 ('*Cansjera leptostachya*'); KANEHIRA, Form. Trees, ed. 2 (1936) 176, f. 128; MERR. J. Agr. Arb. 19 (1938) 25; CORNER, Ways. Trees (1940) 514, f. 173; DESCH, Mal. For. Rec. 15<sup>2</sup> (1954) 431; LIU,



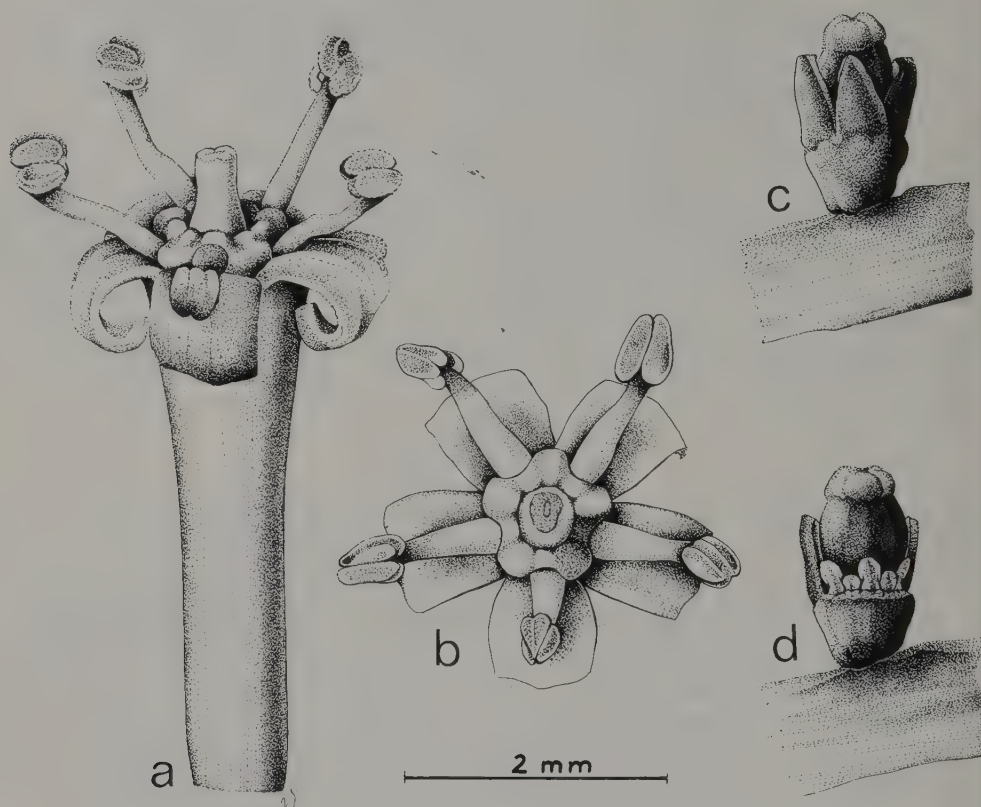


Fig. 1. *Champereia manillana* (BL.) MERR. a-b. ♀ Flower, c. ♀ flower, d. ♀ flower, two tepals removed (a-b GEESINK & HIEPKO 7823, c-d HIEPKO 364). After HIEPKO, 1979.

Illust. Lign. Pl. Taiwan 2 (1962) 808; LI, Woody Fl. Taiwan (1963) 142, f. 50 (*sub Santalaceae*); BACK. & BAKH.f. Fl. Java 2 (1965) 67; HATUS. Mem. Fac. Agric. Kagoshima Univ. 5, 3 (1966) 27; HUANG, Taiwan 14 (1968) 229 (fig. of pollen); LI, Fl. Taiwan 2 (1976) 233, f. 279; HIEPKO, Willdenowia 9 (1979) 16. — *Cansjera manillana* BL. Mus. Bot. Lugd. Bat. 1 (1851) 246. — *Opilia manillana* BAILL. Adansonia 3 (1862) 124. — *Opilia cumingiana* BAILL. l.c. — *Govantesia malulucban* LLANOS, Rev. Progr. Cienc. 15 (1865) 191. — *Champereya gnetocarpa* KURZ, J. Bot. 13 (1875) 325; J. As. Soc. Beng. 45, ii (1876) 123. — *Champereya griffithiana* PLANCH. ex KURZ, J. As. Soc. Beng. 44, ii (1875) 154; HOOK. f. Fl. Br. India 5 (1886) 236 ('*Champereia*' *sub Santalaceae*); GAMBLE, J. As. Soc. Beng. 75, ii (1912) 277; PARKINS. For. Fl. Andam. (1923) 231. — *C. griffithii* PLANCH. ex KURZ, For. Fl. Burma 2 (1877) 330 (*nom. illeg.*); VIDAL, Sin. Atlas

(1883) t. 81, f. D; Phan. Cuming. (1885) 141; Rev. Pl. Vasc. Filip. (1886) 232; RIDL. Fl. Mal. Pen. 3 (1924) 172; BURK. Dict. (1935) 520. — *Nallogia gaudichaudiana* BAILL. Bull. Soc. Linn. Paris 2 (1892) 985. — *C. gaudichaudiana* (BAILL.) TIEGH. Bull. Soc. Bot. Fr. 41 (1894) 65. — *C. cumingiana* (BAILL.) MERR. Philip. J. Sc. 1 (1906) Suppl. 50; ITO, Illust. Form. Pl. (1927) t. 523. — *C. platyphylla* MERR. Philip. J. Sc. 11 (1916) Bot. 177; En. Philip. 2 (1923) 116. — *C. oblongifolia* MERR. Philip. J. Sc. 11 (1916) Bot. 177; En. Philip. 2 (1923) 116. — *C. lanceolata* MERR. Un. Cal. Publ. Bot. 15 (1929) 57. — **Fig. 1, 2, 5b.**

Small tree, mostly 4–8 m, sometimes up to 20 m, or shrub; stem 5–12 (–35) cm ø; bark smooth, pale. Slash wood white to cream. *Leaves* glabrous, ovate, oblong, or lanceolate, (4.5–) 6–18 (–25) by (1.5–) 2–8 (–11) cm; apex slightly acuminate or acute; base shortly attenuate to attenuate, rarely rounded; mid-



Fig. 2. *Champerea manillana* (BL.) MERR. Left: twig with inflorescences with ♀ flowers (RAHMAT SI TOROES 3297); right: young infructescence developed from a ♀ inflorescence (HIEPKO 364). After HIEPKO, 1979.

rib above prominulous; nerves 5–7 (–8) pairs; mid-rib and nerves prominent beneath; petiole 3–5 (–8) mm. *Panicles* solitary or in groups of 2–4; main rachis up to 20 cm long; bracts ovate, acute, 0.5–1 mm long. — ♀ *Flowers*: pedicels 2–5 mm, thickened upwards; tepals yellowish green, 1–1.5 mm, oblong, acute; stamens as long as the tepals, anthers yellow, oval, 0.3 mm long; disk green, annual, crenulate; ovary green, 0.5 mm long. — ♀ *Flowers* green; pedicels c. 0.5 mm long; tepals c. 0.5 mm, acute; staminodes minute, 0.2 mm long, scaly; disk lobes smaller than staminodes; ovary cylindric to ovoid, c. 0.5 mm long; stigma sessile, cushion-shaped. *Drupe* orange-red, (8–) 10–12 (–15) by 7–9 mm; pedicels c. 1.5–2 (–4) mm.

*Distr.* Andamans and SE. Asia to Taiwan, throughout *Malesia* to NW. New Guinea. Fig. 3.

*Ecol.* In open evergreen forest, primary and secondary, and in dry monsoon forest. Mostly at low and medium altitudes, from sea level up to 700 m, sometimes to 900 m (Malay Peninsula) or even 1600 m (N. Borneo). *Fl. fr.* Jan.–Dec., only in the northern part of the area of distribution (e.g. Luzon) more concentrated: *fl.* Dec.–April, *fr.* Jan.–May.

Inflorescences are frequently visited by ants. Fruits eaten by birds.

*Uses.* Young leaves and young fruits are eaten as

vegetables; according to BURKILL (Dict. 1935, 520) and many labels; BURKILL (*l.c.*) and many collectors recorded the fruits to be eaten in Thailand, Malaya, the Kangean Is., Flores, N. Borneo, and the Philippines (Luzon, Palawan). Leaves and roots are pounded to make a poultice for ulcers, and the boiled root is used for rheumatism in Malaya (BURKILL, *l.c.*). Mindanao: leaves pounded and applied for headache and stomachache (*vide* FRAKE *in sched.*).

*Vern.* Malay Peninsula: *belkan* (*sakai*), *chempe-rai*, *chimpri*, *chipreh*, *poko kuching-kuching*, sharing some of these names with *Lepionurus sylvestris*; Sumatra (Simalur): *tutup-mateh*; Flores: *sasang*, *sui*; Philippines (MERR. En. Philip. 2, 1923, 116): *garimo*, *liongliong*, *luingluing*, *malakabuan*, *mala-lukban*, *malaráyap*, *marispáris*, Tag., *ichikamanok*, Tagb., *panalayápin*, Ilk., *panalayápon*, Sbl., *sulan-manok*, Sub., *talaminuk*, Iv.; the main name in Luzon: *malulukban*; Palawan: *duro-manok*, *laniti*; Mindanao: *gelenjup*, *getipun*; Celebes: *borongbenisi*, *kajuwatu*; Talaud Is.: *amaloana*, *aramalu*; Amboina: *sayor garing*.

*Notes.* The species is extremely variable in vegetative characters, especially in form and size of leaves. The greatest variation is found in N. Borneo and the Philippines. Specimens from Luzon (and Taiwan) often have relatively small leaves; the largest

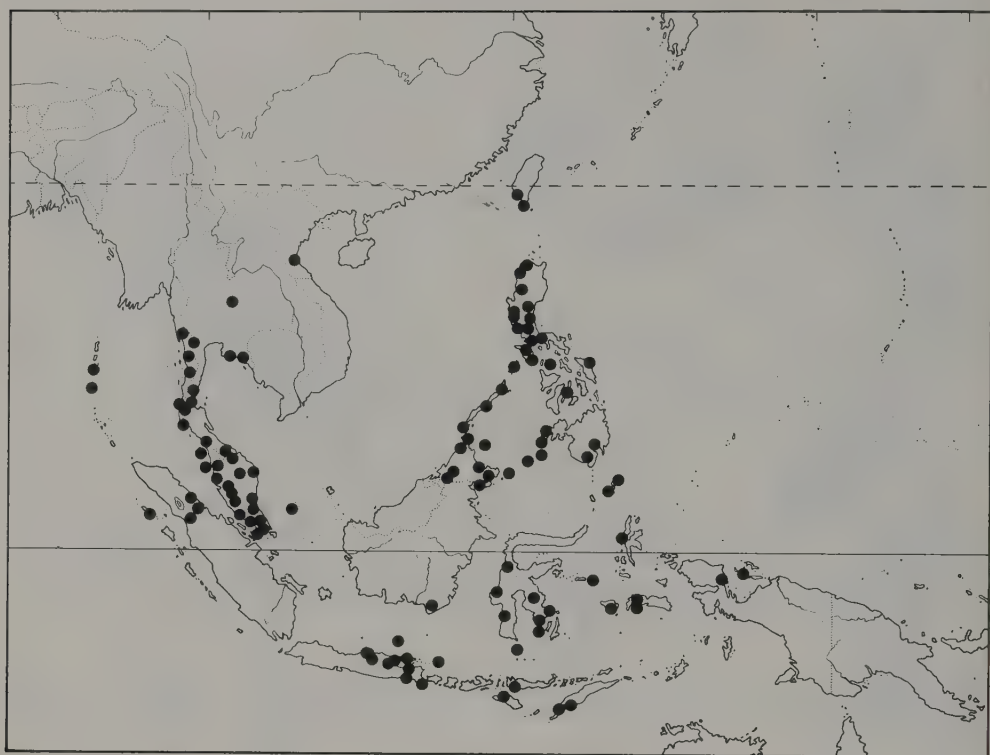


Fig. 3. Range of *Champereia manillana* (Bl.) MERR. After HIEPKO, 1979.

leaves are found in Samar and N. Borneo. But leaves of similar extreme sizes occur in other localities, too, and the number of main side-nerves is rather constant. Therefore it is impossible to accept the species described and named by MERRILL.

The flowers are rather uniform. The ovary of the

♀ flowers obviously develops rarely into a fruit. The variation of the size of the fruits is considerable, but the extreme forms are irregularly scattered over the whole area of distribution, e.g. relatively large fruits occur at the western (Andamans) and at the north-eastern border (Samar) of this area.

## 2. MELIENTHA

PIERRE, Bull. Soc. Linn. Paris 1 (1888) 762; BAILL. Hist. Pl. 11 (1892) 457; ENGL. in E. & P. Nat. Pfl. Fam. Nachtr. 1 (1897) 143; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 36; HIEPKO, Willdenowia 9 (1979) 23. — **Fig. 4, 5a.**

Small trees; branchlets glabrous. *Leaves* glabrous, coriaceous-fleshy, in dry state hard and brittle. Plants dioecious. *Flowers* in panicle-like branched inflorescences; rachises minutely papillate to puberulous. *Inflorescences* mostly on the main trunk but also on branches and even in the axils of the uppermost leaves. Flowers 4- or 5-merous. — ♂ *Flowers* sessile, solitary or in groups of 3–5 (mainly at the end of the rachises) in the axil of a minute bract. Tepals reflexed. Filaments very short, attached to the base of the tepals; anthers relatively



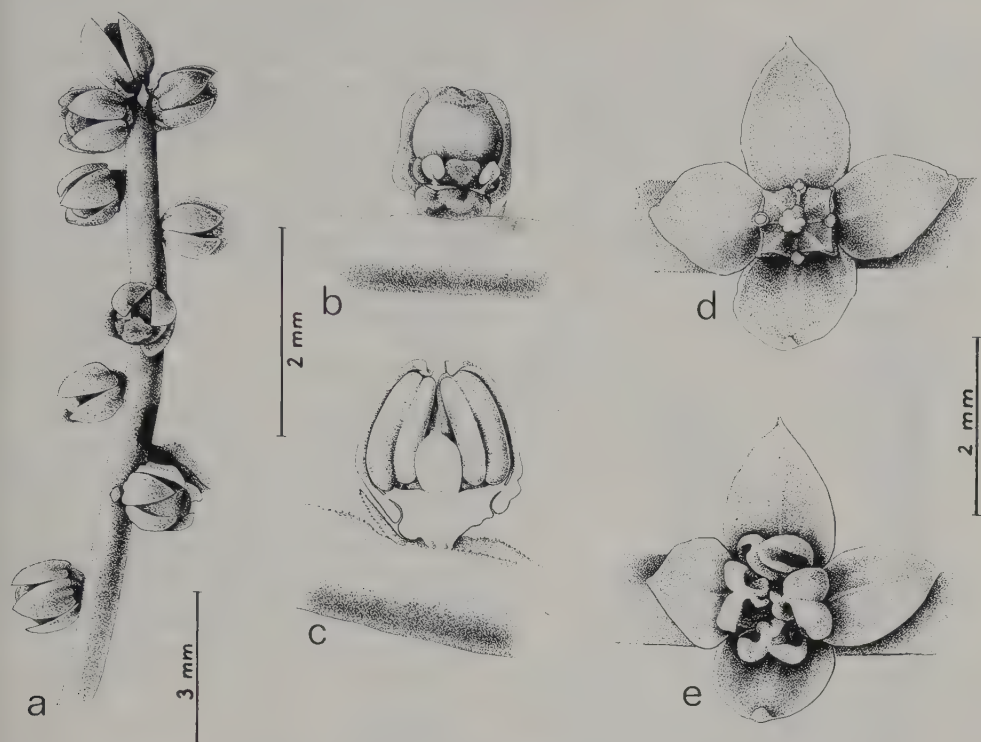


Fig. 4. *Melientha suavis* PIERRE *spp. suavis*. *a*. Part of a ♀ inflorescence, *b*. ♀ flower, two tepals removed, *c*. LS of a ♂ flower-bud, *d*. ♂ flower, the stamens removed, *e*. ♂ flower (*a-c* PUT 666, *d-e* MAXWELL 75-70). After HIEPKO, 1979.

large. Disk lobes fleshy, as large as the rudimentary ovary. — ♀ *Flowers* solitary per bract, sometimes in groups of 3–4, with very short pedicels. Tepals adjacent to the ovary; the small staminodes alternating with broad disk lobes. *Drupe* pedicelled, ellipsoid to slightly ovoid or obovoid; pericarp thin, 1.5–2 mm thick, mesocarp fleshy-juicy, endocarp woody. *Embryo* nearly as long as the seed, with small radicle (2 mm) and 3–4 long, narrow cotyledons.

Distr. Monotypic, SE. Asia (Indochina, Thailand) and *West Malesia*: Malaya, Borneo, and the Philippines. Fig. 6.

Ecol. Primary, mostly deciduous forest, from the lowland up to 1500 m.

**1. *Melientha suavis*** PIERRE, Bull. Soc. Linn. Paris 1 (1888) 763; Fl. Coch. fasc. 17 (1892) t. 264B; GAGNEP. Fl. Gén. I.-C. 1 (1911) 802, f. 89; *ibid.* Suppl. 1 (1948) 731; HIEPKO, Willdenowia 9 (1979) 23. — *M. acuminata* MERR. Philip. J. Sc. 29 (1926) 477. — **Fig. 4, 5a.**

Small tree up to 13 m. *Leaves* lanceolate, elliptic to ovate (or rarely obovate), (4–) 6–12 (–16) by 2.5–5 (–7) cm; apex obtuse- or retuse-mucronulate, some-

times acute to acuminate; base cuneate-attenuate; nerves 5–6 (–8) pairs; hardly prominulous on both sides; petiole 1–5 mm. *Inflorescences* often in groups on swellings at the trunk or solitary on branches and in axils of leaves; main rachis up to 15 cm, in fruiting state up to 20 cm; bracts ovate, acute, c. 0.5 mm long. *Flowers*: see under the subspecies. *Drupe* yellow, 2.3–4 by 1.5–2 cm; pedicels 3–7 mm.



Fig. 5. *Melientha suavis* PIERRE *ssp. suavis*. a. Inflorescences. — *Champereia manillana* (BL.) MERR. b. Inflorescence developed from an inflorescence with ♂ flowers (a MAXWELL 75-452, b HARDIAL & SAMSURI 226). After HIEPKO, 1979.

#### KEY TO THE SUBSPECIES

1. Drupe ellipsoid or slightly ovoid, 2.3–3 cm long  
a. *ssp. suavis*
1. Drupe slightly obovoid, 3.5–4 cm long  
b. *ssp. macrocarpa*

#### a. *ssp. suavis*.

Small tree up to 11 m; bark grey, smooth or fissured; wood white. *Leaves*: see under the species; petiole 1–2 mm. Main rachis of the infructescence up to 5 mm ø. — ♂ *Flowers*: tepals greenish, c. 1.5 mm, oblong, acute; anthers yellow, almost sessile, oval, 1–1.5 mm long. Disk lobes and rudiment of ovary thick, irregularly angular, c. 0.5 mm long. — ♀ *Flowers* green; pedicels less than 0.5 mm; tepals c. 1 mm, acute; staminodes shorter than 0.5 mm; disk lobes as long as the staminodes, but much broader. Ovary globose, c. 1 mm, stigma sessile. *Drupe* ellipsoid or ± ovoid, 2.3–3 by 1.5–1.7 cm; in herb. usually yellowish brown; pedicels 3–5 mm.

*Distr.* Thailand, Laos, Vietnam, Cambodia; in *Malesia*: Malay Peninsula and Philippines (Mindanao). Fig. 6.

*Ecol.* In deciduous forest, locally common, rarely in dry evergreen forest. From sea level (in beach forest) up to 600 m. *Fl.* Dec. – March; *fr.* April – July. Flowers strongly fragrant.

*Uses.* Young shoots and inflorescences are eaten after boiling as a vegetable (notes of many collectors). Fruits edible.

*Vern.* Philippines: *malatado*, Mindanao.

*Note.* *Melientha suavis ssp. suavis* varies considerably in leaf characters. The apex of the leaves is often obtuse-mucronulate but more or less acuminate leaves are to be found at several points of the range of the subspecies.

b. *ssp. macrocarpa* HIEPKO, Willdenowia 9 (1979) 28.

Small tree up to 13 m, girth of the stem up to 45 cm; bark smooth, grey; wood white. *Leaves* lanceolate, elliptic or slightly obovate, 8–15 by 2.3–4.5 cm; apex shortly acuminate; base cuneate-attenuate; petiole 2–5 mm long. *Flowers* not seen (according to KEP 80403 the inflorescences are attached to the stem and the flowers are 'apetalous, 4 green sepals, 4 stamens'). Main rachis of the infructescence up to 7 mm ø. *Drupe* ellipsoid to ± obovoid, 3.5–4 by 2 cm, in herb. dark brown; pedicels 7 mm long.

*Distr.* *Malesia*: N. Borneo (Mt Kinabalu: Kota Belud). Fig. 6.

*Ecol.* In primary forest up to 1500 m, on black rocky soil. *Fr.* July and Aug.

*Vern.* *Tangal*.

*Note.* The fruits of this subspecies differ considerably in form and size, the structure of the pericarp and of the seed corresponds to that of *M. suavis ssp. suavis*.

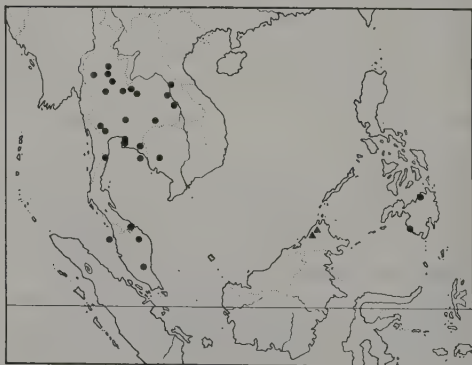


Fig. 6. Range of the genus *Melientha* PIERRE: *M. suavis* PIERRE *ssp. suavis* (dots), *M. suavis* PIERRE *ssp. macrocarpa* HIEPKO (triangles). After HIEPKO, 1979.

## 3. UROBOTRYA

STAPF, J. Linn. Soc. London 37 (1905) 89; HIEPKÖ, Ber. Deut. Bot. Ges. 84 (1972) 662; Willdenowia 9 (1979) 29. — *Opilia* subg. *Urobotrya* (STAPF) ENGL. Bot. Jahrb. 43 (1909) 171; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 38. — **Fig. 7.**

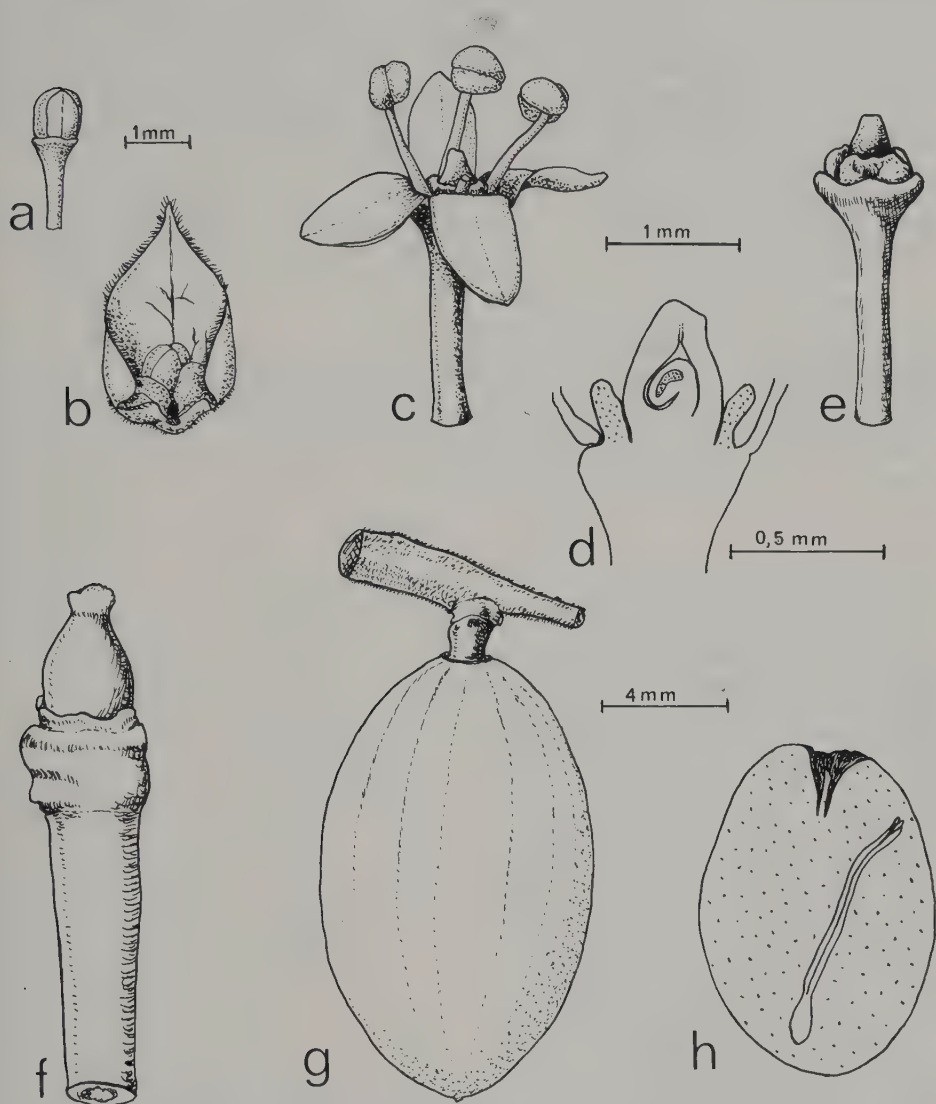


Fig. 7. *Urobotrya parviflora* HIEPKÖ. a. Flower-bud, b. bract (with 3 buds), c. flower, one stamen cut off, d. LS of pistil and disk, e. flower, tepals and stamens removed, f. pistil with disk, after flowering, g. fruit, h. LS of seed (a, c, e NED1738, holotype, b SAN 35987, d KOSTERMANS21116, f KOSTERMANS21069, g AMDJAH 370, h WOOD 1273). After HIEPKÖ, 1979.



## Section Lepionuroides

HIÉPKO, Willdenowia 6 (1972) 471; Nat. Hist. Bull. Siam Soc. 27 (1978) 121; Willdenowia 9 (1979) 29.

Shrubs or small trees, twigs glabrous or puberulous. *Leaves* glabrous or midrib hairy, thinly-coriaceous. *Flowers* bisexual, in racemes, usually three pedicelled flowers per bract; rachis of inflorescence slender, glabrous or puberulous. Bracts broad, green, with hyaline ciliate margin, densely imbricate, caducous before anthesis, only some basal (smaller) bracts persistent. Flowers 3- or 4 (-5)-merous. Tepals free, oblong, acute. *Stamens* exceeding the perianth. Disk annular, fleshy. Ovary conical to cylindric; stigma sessile. *Drupe* ellipsoid, mesocarp thinly-fleshy; embryo with 3 long cotyledons.

**Distr.** The range of this section: 5 spp. in Thailand, S. Burma, Laos, S. China, Vietnam; in *Malesia*: 2 spp. in Borneo and Flores. Fig. 8.

**Ecol.** Evergreen (in Thailand rarely deciduous) forest, from the lowland up to c. 550 (-1000) m.

**Uses.** Leaves and/or fruits of *U. siamensis* HIÉPKO in Thailand locally used as a medicine against intestinal parasites, in large amounts a deadly poison.

**Taxon.** The genus was originally restricted to western tropical Africa (*Urobotrya* sect. *Urobotrya* with 2 spp.). This section is characterized by much longer racemes with small, narrowly triangular bracts.

Two species from Indochina were originally described under *Lepionurus*. The young inflorescences are indeed very similar to those of that genus, but the structure of the flowers differs considerably (cf. HIÉPKO, Ber. Deut. Bot. Ges. 84, 1972, 661-663). Anatomical and palynological data support the opinion that *Urobotrya* and *Lepionurus* are closely allied mutually and to *Gjellerupia*.

## KEY TO THE SPECIES

1. Racemes 4.5-5.5 cm long, rachis glabrous. Tepals mostly 3. Drupe 14-16 by 7 mm    **1. *U. floresensis***
1. Racemes 8-12 cm long, rachis densely puberulous. Tepals mostly 4. Drupe 13 by 8.5 mm    **2. *U. parviflora***

**1. *Urobotrya floresensis* HIÉPKO, Willdenowia 9 (1979) 32.**

Small treelet, up to 3 m. Twigs puberulous. *Leaves* glabrous, only the midrib underneath with short hairs; ovate to elliptic, (5-) 8-12 (-16) by (2-) 3-4.5 (-6.5) cm; apex shortly acuminate, base rounded to cuneate; nerves 7-8 on each side of the midrib; petiole 1-2 mm. *Inflorescences* axillary, solitary; rachis (3-) 4.5-5.5 cm, glabrous. Bracts broadly ovate, apiculate, 2.5-3 by 2.5-3 mm. *Flowers* 3 per bract, without bracteoles; pedicels 1.5 mm. *Tepals* 3, rarely 4, c. 1 mm. *Stamens* white, filament c. 1 mm. Disk cup-shaped, up to nearly half the length of the ovary. *Ovary* cylindric to conical, 0.7 mm long; stigma tripartite. *Drupe* 14-16 by 7 mm; pedicel 3 mm.

**Distr.** *Malesia*: Lesser Sunda Is. (W. Flores: Manggarai), 5 collections. Fig. 8.

**Ecol.** From the lowland up to 800 m, according to SCHMUTZ (in sched.) gregarious (like in *U. siamensis*).

**Vern.** *Sasang manuk* (cf. *Opilia amentacea*).

**Note.** This species is distinguished by several

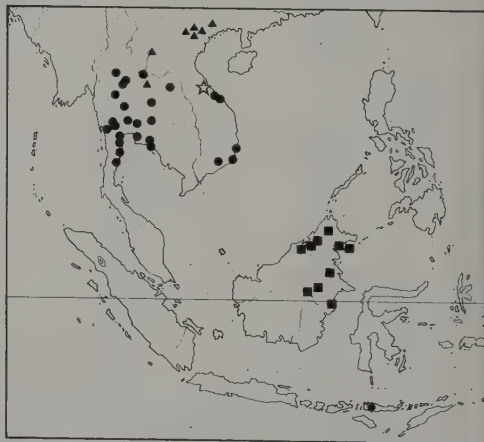


Fig. 8. Range of *Urobotrya* STAPF sect. *Lepionuroides* HIÉPKO: *U. floresensis* HIÉPKO (rhomb), *U. latiquama* (GAGNEP.) HIÉPKO (triangles), *U. longipes* (GAGNEP.) HIÉPKO (star), *U. parviflora* HIÉPKO (squares), *U. siamensis* HIÉPKO (dots). After HIÉPKO, 1979.

characters partly typical for some other species of the genus: puberulous twigs, relatively small flowers, and large fruits (like *U. parviflora*), glabrous and comparatively short rachis (like *U. siamensis*). A unique character of *U. floresensis* is the trimerous flower, not only with three tepals and stamens, but also showing a tripartite stigma.

**2. *Urobotrya parviflora* HIEPKO**, Willdenowia 6 (1972) 474; *ibid.* 9 (1979) 34. — *Cansjera* sp.? MERR. Un. Cal. Publ. Bot. 15 (1929) 57. — **Fig. 7.**

Shrub, 1–5 m, twigs puberulous. *Leaves* glabrous, but midrib pilose on both sides, elliptic to broadly ovate or lanceolate, (6–) 8–13 (–17) by (1–) 2.5–5 (–7) cm; apex shortly acuminate, base rounded or cuneate; midrib prominent and rounded, nerves less prominent beneath, 6–8 pairs; petiole 1–3 (–5) mm long. *Inflorescences* axillary, usually solitary, rarely

in twos; rachis 8–12 cm long, densely puberulous. Bracts broadly ovate, acuminate, 3–4 by 4 mm, finely hairy on both sides. *Flowers* 3 per bract, without bracteoles; pedicels 1–1.5 mm. *Tepals* (3–) 4 (–5), whitish, c. 1 mm. *Stamens* white, filaments c. 1 mm, anthers elliptic, c. 0.5 mm long. Disk annular, low. *Ovary* conical, c. 0.5 mm long. *Drupe* slightly apiculate, red, mesocarp juicy, 13 by 8.5 mm; pedicels up to 2.5 mm.

Distr. *Malesia*: Borneo (Brunei, Sabah, N. & NE. Kalimantan). Fig. 8.

Ecol. In primary and secondary evergreen forest, from sea level up to 540 m. *Fl. fr.* Jan.–Dec.

Note. Form and size of the leaves are extremely variable; besides rather broadly ovate leaves narrowly lanceolate leaves are found (KOSTERMANS 21116: 12 by 1 cm). Inflorescences, flowers and fruits are fairly uniform.

#### 4. LEPIONURUS

BL. Bijdr. (1826) 1148; ENDL. Gen. Pl. 2 (1840) 1041; B. & H. Gen. Pl. 1 (1862) 349; VALET. Crit. Overz. Olacin. (1886) 151; ENGL. in E. & P. Nat. Pfl. Fam. 3, 1 (1889) 241 (*sub Olacaceae*); BAILL. Hist. Pl. 11 (1892) 456 (*sub Lorantheae*); SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 35; HIEPKO, Willdenowia 9 (1979) 38. — *Leptonium* GRIFF. Calc. J. Nat. Hist. 4 (1843) 236; Flora 27, 2 (1844) 435. — *Opilia* sect. *Lepionurus* (BL.) BAILL. Adansonia 3 (1862) 124. — **Fig. 9, 10.**

Shrubs, erect or straggling, usually glabrous, sometimes young twigs with short hairs. *Leaves* glabrous, thinly coriaceous. *Flowers* bisexual, in axillary racemes, three flowers per bract; rachis of inflorescence slender, glabrous. Bracts broad scaly, pale green, with hyaline, shortly ciliate margin, densely imbricate, caducous before anthesis (lowermost bracts smaller, sterile and persisting). *Flowers* (3–) 4 (–5)-merous. *Perianth* united, deeply lobed. *Stamens* not exceeding the perianth, filaments flattened. Disk cupular, with irregularly lobed margin. *Ovary* ovoid-conical; stigma  $\pm$  sessile, entire or shallowly 4-lobed. *Drupe* ellipsoid to somewhat ovoid or obovoid; pericarp thin, mesocarp juicy, endocarp crustaceous. *Embryo* nearly as long as the seed, radicle small, with 3–4 long, linear cotyledons.

Distr. Monotypic. SE. Asia (Nepal to Vietnam) and *W. Malesia*: Sumatra, Malaya, Java, Borneo. Fig. 11.  
Ecol. Undergrowth in evergreen forest, from the lowland up to 1250 (–2000) m.

**1. *Lepionurus sylvestris* BL.** Bijdr. (1826) 1148; MIQ. Fl. Ind. Bat. 1, 1 (1856) 784; KURZ, For. Fl. Burma 2 (1877) 330 (*sub Santalaceae*); VALET. Crit. Overz. Olacin. (1886) 153, *incl. var. lanceolata* VALET.; BOERL. Handl. 1 (1890) 210; KING, J. As. Soc. Beng. 64, ii (1895) 593; BRANDIS, Indian Trees (1906) 150; GAGNEP. Fl. Gén. I.-C. 1 (1911) 806; KOORD. Exk.

Fl. Java 2 (1912) 170; *ibid.* 4 (1925) 581, f. 863; RIDL. Fl. Mal. Pen. 3 (1924) 172; BURK. Dict. (1935) 1353; KANJILAL c.s. Fl. Assam 1 (1936) 250; CORNER, Ways. Trees (1940) 515; BACK. & BAKH. f. Fl. Java 2 (1965) 67; HIEPKO, Willdenowia 9 (1979) 29. — *L. javanicus* G. DON, Gen. Syst. 2 (1832) 16, *nom. illeg.* — *Leptonium oblongifolium* GRIFF. Calc. J. Nat.

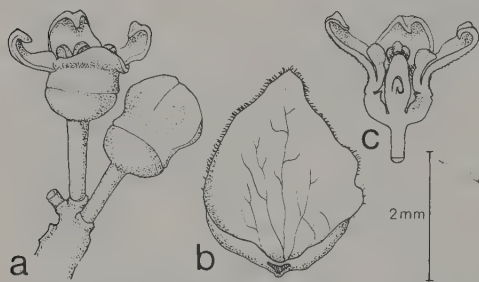


Fig. 9. *Lepionurus sylvestris* BL. a. Two flowers of a triad, one just opened, b. bract, c. LS of flower (NICOLSON 3072). After HIEPKO, 1979.

Hist. 4 (1843) 237; Flora 27, 2 (1844) 435; Not. Pl. As. 4 (1854) 368; Ic. Pl. As. 4 (1854) pl. 536. — *Opi-  
lia acuminata* WALL. [Cat. (1829) 243, n. 7206, *nom.  
nud.*] ex BAILL. Adansonia 3 (1862) 124. — *L. ob-  
longifolius* (GRIFF.) MAST. Fl. Br. India 1 (1875) 583;  
KOORD. Exk. Fl. Java 2 (1912) 170; RIDL. Fl. Mal.  
Pen. 3 (1924) 173, incl. *var. angustifolius* RIDL. —  
Fig. 9, 10.

Shrub, usually less than 2 m, rarely up to 6 m.  
Leaves extremely variable in shape, (5.5–) 10–16  
(–25) by (1.5–) 3–7 (–9) cm, ratio 2–4 (–10), widest



Fig. 10. *Lepionurus sylvestris* BL. Young inflorescences (GEESINK, HIEPKO & PHENGKLAI 7567). Photogr. HIEPKO, Nov. 1974.

above, at, or below the middle; obovate, oblong, lanceolate or ovate; apex acutely acuminate, base shortly attenuate or attenuate; (5–) 8–10 (–13) pairs of nerves, midrib and side-nerves often prominent beneath; petiole 1–5 (–8) mm. Racemes 1–8 (–17) per axil; rachis erect, drooping or pendulous, 2–5 cm (in fruit up to 6 cm). Bracts broadly ovate, acuminate or apiculate, 4–5 (–7.5) by 3–5 (–8) mm. Flowers 3 per bract, on a tubercle, without bracteoles; pedicels 1–2 mm. Tepals united, tube 0.5 mm long, resting on the cupular hypanthium. Perianth yellowish, 2–4.5 mm across; segments patent, ovate, acute. Stamens inserted below the margin of the disk, as long as the perianth tube; anthers oval, 0.5 mm long. Pistil c. 1 mm long. Drupe resting on the thickened disk, orange-red, 9–16 by 6–10 mm; pedicel 2–2.5 mm, thick, seemingly longer through the enlarged tubercle on the thickened rachis. Embryo nearly as long as the seed, radicle about half as long as the cotyledons.

Distr. Nepal, Sikkim, Assam, Burma, S. China, Thailand, and S. Vietnam; in Malesia: Sumatra, Malay Peninsula (common), W. Java (common), rarely in Central Java, Borneo (Sarawak, Sabah, Kalimantan). Fig. 11.

Ecol. Usually in evergreen forest, locally common undergrowth, from sea level up to 1250 m, rarely up to 2000 m (Sumatra). Fl. fr. Jan–Dec.

RAZI (Lloydia 20, 1958, 238) mentioned *Lepionurus* in his list of phanerogamic parasites, but he does not give any evidence as proof of this statement.

Uses. In Peninsular Thailand the roots are locally used for a medicine against fever. In Pahang (Malaya) a poultice of the plant or of the root is applied for headache (BURKILL, 1935).

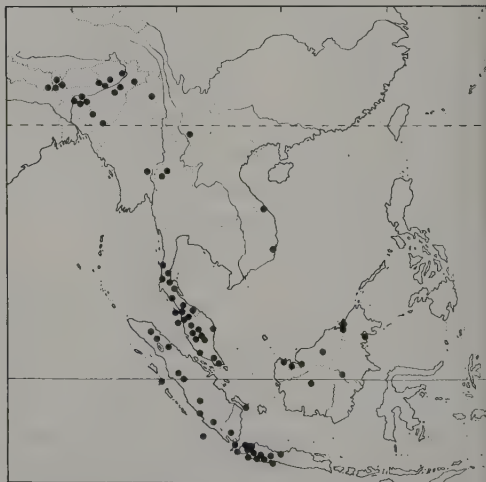


Fig. 11. Range of *Lepionurus sylvestris* BL. After HIEPKO, 1979.



Notes. As already pointed out by VALETON (Crit. Overz. Olacin. 1886, 152) the leaves of *L. sylvestris* are extraordinarily variable in shape and size. Extremely narrow leaves (ratio about 10) are especially striking, but such forms occur sporadically in all parts of the range of the species next to plants with a more common leaf shape (Burma, Thailand, Malaya, Sumatra).

The number of inflorescences per axil is also very

variable. Whereas in the greater part of the range 1–8 racemes are found, one third of the specimens from Assam show in part more than 10 racemes per axil.

The size of the flowers and the differentiation of the rim of the disk are variable as well. Since this variability is quite irregular it is impossible to distinguish varieties.

## 5. GJELLERUPIA

LAUT. Nova Guinea 8 (1912) 817, t. 149; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 40; STEEN. Nova Guinea, Bot. 12 (1963) 192; HIEPKO, Willdenowia 9 (1979) 36. — **Fig. 12.**

Shrubs or small trees, twigs puberulous. *Leaves* glabrous, but midrib hairy above, coriaceous. Plants dioecious. *Flowers* in racemes, 1–3 pedicelled flowers per bract; rachis of inflorescence slender, glabrous, rarely with some scattered hairs. Bracts broadly cordate, green, with hyaling ciliate margin, densely imbricate, caducous before anthesis, only some basal (smaller) bracts persistent. — ♂ *Flowers* (3–) 4 (–5)-merous. Tepals free, oblong, acute, reflexed. Stamens



Fig. 12. *Gjellerupia papuana* LAUT. a. Twig with infructescence, b. ♀ flower, c. bract from a ♂ inflorescence, d. ♂ flower, one tepal and one stamen removed (a DARBYSHIRE & HOOGLAND 8232, b GJELLERUP 170, syntype, c KOSTERMANS & SOEGENG 266, d KOSTERMANS & SOEGENG 390). After HIEPKO, 1979.

exceeding the perianth. Disk annular, fleshy. Pistil rudimentary. — ♀ *Flowers* without perianth and stamens. Disk annular, thinly-fleshy. Ovary  $\pm$  conical; stigma sessile. *Drupe* almost globular, mesocarp juicy, endocarp thinly crustaceous; embryo nearly as long as the seed, with 3–4 long, linear cotyledons.

Distr. Monotypic. *Malesia*: New Guinea.

Ecol. Undergrowth in high evergreen forest, often on limestone ridges, from the lowland up to 200 m.

Note. *Gjellerupia* was reduced by HATUSIMA (Bot. Mag. Tokyo 65, 1952, 110) to *Lepionurus sylvestris* BL., but VAN STEENIS (*l.c.*) pointed out that the observations and conclusions of HATUSIMA are erroneous and that *Gjellerupia* is a distinct genus. It is closely allied to *Urobotrya*. The male flowers of *Gjellerupia* show a striking similarity with those of *e.g.* *Urobotrya siamensis*. Furthermore the pollen type (LOBREAU-CALLEN, pers. comm.) and the placentation are the same in both genera.

**1. *Gjellerupia papuana*** LAUT. Nova Guinea 8 (1912) 817, t. 149; SCHELLENB. Bot. Jahrb. 58 (1923) 157; HIEPKO, Willdenowia 9 (1979) 37. — **Fig. 12.**

Shrub or small tree up to 6 m, with few horizontal branches. Bark light grey, smooth. Wood hard, straw coloured. *Leaves* ovate to narrowly lanceolate, 5–15 (–17) by 1.5–4 (–5.5) cm; apex acute to acuminate, base attenuate to rounded; lateral nerves 8–15 pairs, midrib prominent beneath; petiole 1–4 mm. *Inflorescences* axillary, usually solitary, rarely 2 or 3 together; rachis 1–2 cm long (in fruiting state up to 2.5 cm). Bracts 2–3 by 2–3.5 mm. — ♂ *Flowers* 1–3 per bract; pedicels 1.5–4 mm long. Tepals 1.5–2 mm long. Stamens 1.5–2.5 mm; anthers subcordate, 0.3

mm long. Disk undulate. Rudimentary pistil cylindrical, up to c. 1 mm long, spindly. — ♀ *Flowers* 1–3 per bract. Tepals and stamens 0. Disk 0.5 mm. Ovary conical, 1 mm long. *Drupe* red, 10–12 mm  $\varnothing$ ; pedicel 5–7 mm long, often bent.

Distr. *Malesia*: New Guinea (Geelvink Bay, Jayapura, West Sepik & Sepik Distr.).

Ecol. Locally common as undergrowth in high evergreen forest, often on limestone ridges; from sea level up to 200 m. *Fl. fr.* Jan.–Dec.

Vern. *Maroa*, Orne lang.

Note. The species is rather variable in form and size of the leaves; flowers and fruits are fairly uniform.

## 6. OPILIA

ROXB. Pl. Corom. 2 (1802) 31, t. 158; R. & S. Syst. Veg. 5 (1819) 275; ENDL. Gen. Pl. 2 (1840) 1041; B. & H. Gen. Pl. 1 (1862) 350; BAILL. Adansonia 3 (1862) 123; BTH. Fl. Austr. 1 (1863) 394; OLIV. Fl. Trop. Afr. 1 (1868) 352; VALET. Crit. Overz. Olacin. (1886) 153; ENGL. in E. & P. Nat. Pfl. Fam. 3, 1 (1889) 240 (*sub Olacaceae*); BAILL. Hist. Pl. 11 (1892) 456; ENGL. in E. & P. Nat. Pfl. Fam. Nachtr. 1 (1897) 143; SLEUM. in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 38 (*incl. Urobotrya*); LUCAS, Fl. Trop. E. Afr., Opil. (1968) 1; HIEPKO, Willdenowia 12 (1982) 161. — *Groutia* GUILL. & PERR. Fl. Seneg. Tent. (1831) 100, t. 22. — *Tetanosisia* RICH. ex M. ROEMER, Syn. Hesper. 1 (1846) 23. — *Pentitdis* ZIPP. ex BL. Mus. Bot. Lugd. Bat. 1 (1851) 246, *pro syn.*

Lianas, sometimes erect shrubs, root parasites; young branchlets glabrous or tomentose to puberulous. *Leaves* coriaceous. *Flowers* bisexual, in axillary racemes, three per bract. Rachis of racemes and pedicels densely covered with brownish or yellowish hairs. Bracts peltate, broadly ovate, densely imbricate, caducous before anthesis. *Tepals* free, 5–4, recurved. *Stamens* exceeding the perianth. Disk lobed, with 5–4 thick and fleshy, irregularly toothed lobes alternating with the stamens. *Ovary* cylindric to ellipsoid, stigma sessile. *Drupe* ellipsoid, puberulous, mesocarp fleshy, endocarp thin, woody. *Embryo* nearly as long as the seed, radicle extremely small (c. 0.5 mm), with 3 cotyledons.

Distr. In tropical Africa 2 spp., *O. amentacea* also from India through Burma, Thailand, Indochina, and Malesia to the Solomon Is. and N. Australia. Fig. 13.

Ecol. In dry deciduous forest, often in beach forest, from the lowland up to 600 (–1200) m.

**1. *Opilia amentacea* ROXB.** Pl. Corom. 2 (1802) 31, t. 158; Fl. Ind. ed. Carey 2 (1832) 87; MIQ. Fl. Ind. Bat. 1, 1 (1856) 784; BTH. Fl. Austr. 1 (1863) 394; OLIV. Fl. Trop. Afr. 1 (1868) 352; MAST. Fl. Br. India 1 (1875) 583; KURZ, For. Fl. Burma 1 (1877) 238; VIDAL, Sin. Atlas (1883) t. 30, f. B; Rev. Pl. Vasc. Filip. (1886) 86; VALET. Crit. Overz. Olacin. (1886) 154; BOERL. Handl. 1 (1890) 212; WARB. Bot. Jahrb. 13 (1891) 300; TRIM. Fl. Ceyl. 1 (1893) 258; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 301; BRANDIS, Indian Trees (1906) 150; MERR. Philip. J. Sc. 1 (1906) Suppl. 50; THONNER, Blütenpfl. Afr. (1908) t. 36; GAGNEP. Fl. Gén. I.-C. 1 (1911) 804; KOORD. Exk. Fl. Java 2 (1912) 170; MERR. Fl. Manila (1912) 184; GAMBLE, Fl. Pres. Madras 1 (1915) 192; EWART & DAVIES, Fl. N. Territ. (1917) 90; MERR. En. Philip. 2 (1923) 115; HAINES, Bot. Bihar Orissa 1 (1925) 190; KOORD. Exk. Fl. Java 4 (1925) 579, f. 861; BACK. & BAKH. f. Fl. Java 2 (1965) 66; HIEPKÖ, Willdenowia 12 (1982) 162, f. 1-4. — *Grouatia celtidifolia* GUILL. & PERR. Fl. Seneg. Tent. (1831) 100, t. 22. — *Ximenia* (?) *olacioides* W. & A. Prod. (1834) 89. — *O. celtidifolia* (GUILL. & PERR.) ENDL. ex WALP. Rep. Bot.

Syst. 1 (1842) 377; KEAY, Fl. W. Trop. Afr. ed. 2, 1, 2 (1958) 651; GARCIA, Fl. Zambes. 2 (1963) 336; LUCAS, Fl. Trop. E. Afr., Opil. (1968) 2. — *Tetanosia olacioides* (W. & A.) M. ROEMER, Syn. Hesper. 1 (1846) 23. — *O. pentitidis* BL. Mus. Bot. Lugd. Bat. 1 (1851) 246; MIQ. Fl. Ind. Bat. 1, 1 (1856) 784; VALET. Crit. Overz. Olacin. (1886) 155. — *O. javanica* MIQ. Fl. Ind. Bat. 1, 1 (1856) 784. — *O. tomentella* (OLIV.) ENGL. Pflanzenw. Ost-Afr. C (1895) 168; GARCIA, Fl. Zambes. 2 (1963) 338. — *O. thorelii* GAGNEP. Not. Syst. 1 (1910) 206; Fl. Gén. I.-C. 1 (1911) 804, f. 90. — *O. fragrans* ELMER, Leaf. Philip. Bot. 5 (1912) 1824.

Liana up to 30 m or erect shrub; bark smooth or fissured, pale to dark grey, branches glabrous or glabrescent. Leaves mostly glabrous; ovate, oblong, or lanceolate, 5–14 (–16) by 2–5 cm; apex acuminate, acute, or obtuse; base attenuate, sometimes rounded; midrib prominent beneath; nerves (6–) 7–9 (–11) pairs; petiole 3–7 (–10) mm. Racemes 1–5 in the axil of one leaf, 1.5–3.5 cm long when flowering; bracts 2–3 mm ø, with ciliate margin. Pedicels of 1.5–2 mm. Tepals yellowish green, oblong with a short inflexed top, shortly pubescent out-

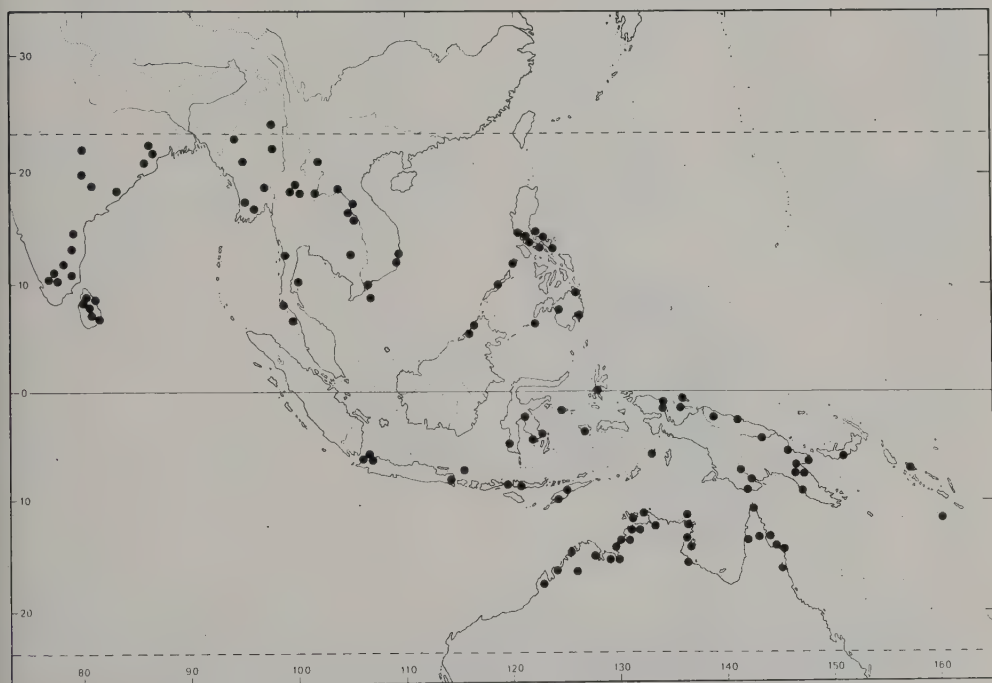


Fig. 13. Range of *Opilia amentacea* ROXB. in the eastern Old World.



side, c. 1.5 mm long. *Filaments* filiform, 1.5 mm; anthers oval, 0.3 mm long. Disk lobes subclavate, green, c. 0.5 mm long. *Ovary* c. 1 mm long. *Drupe* orange-yellow, 1.5–3 by 1.25–1.75 cm; pedicels thickened upwards, 5–7 mm.

*Distr.* Tropical Africa, and from India and Sri Lanka through Burma, Thailand, Indochina, and *Malesia* to the Solomon Is. and Australia. Fig. 13.

*Ecol.* In dry deciduous forests or thickets (in New Guinea in light rain-forest), often on seashore or along streams; on limestone, sandstone, or volcanic tuff; from sea level up to 600 m (in New Guinea up to 1000 m). *Fl. fr.* Jan.–Dec. Flowers sweet scented.

The root-parasitism was studied by BARBER (Proc. Cambridge Phil. Soc. 14, 1907, 246–256).

Pea-shaped galled flowers have been observed in

some specimens from the Philippines, N. Borneo, and from New Guinea.

*Uses.* The fleshy mesocarp of the fruit is edible, but it is only reported from different parts of Africa and N. Australia that the fruits are eaten.

*Vern.* Philippines: *agaroiroi*, P. Bis., *aratig*, *campenaya*, *toolongan*, Tagb.; Komodo: *landa*; Flores: *sasang manuk* (cf. *Urobotrya floresensis*).

*Note.* Like the other members of *Opiliaceae* this species is extremely variable in vegetative characters. Form, size, and texture of the leaves vary considerably as well as the measurements of the fruits, but the geographical distribution of these differences is irregular. The differences in the indumentum of the young twigs are also irregularly distributed. Inflorescences and flowers are uniform.

## 7. CANSJERA

JUSS. Gen. (1789) 448, *nom. cons.*; ENDL. Gen. Pl. 1 (1837) 331; MEISN. in DC. Prod. 14 (1857) 519; B. & H. Gen. Pl. 1 (1862) 349; BAILL. Adansonia 3 (1862)

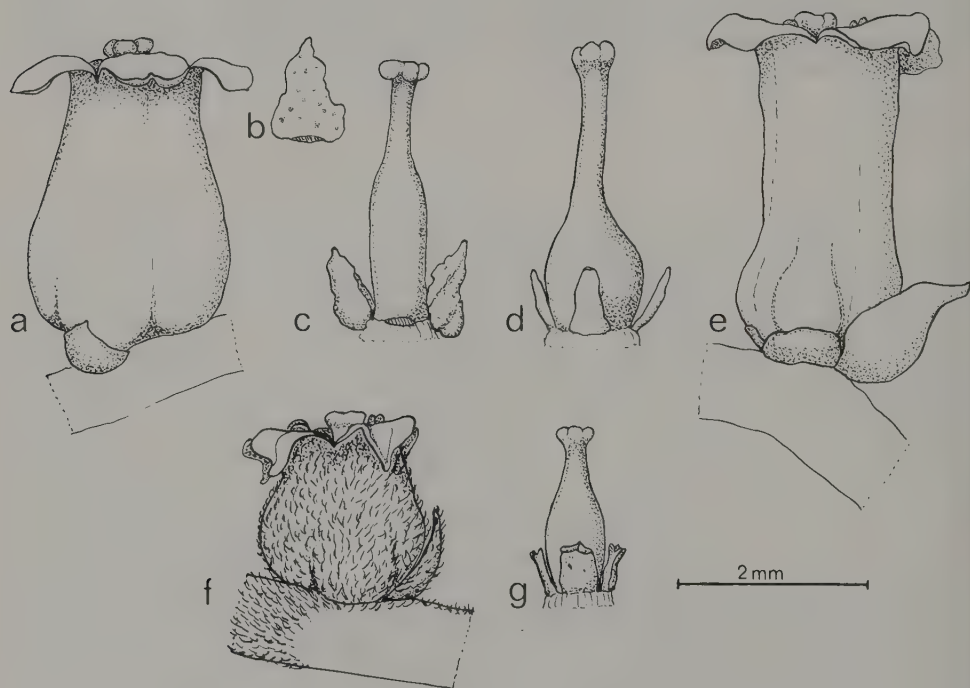


Fig. 14. *Cansjera rheedii* J.F. GMELIN. a. Flower with bract, without indumentum, b. disk scale, adaxial view, c. pistil and disk, one scale removed. — *C. parvifolia* KURZ. d. Pistil with disk scales, e. flower with bract, without indumentum. — *C. leptostachya* BTH. f. Flower with bract, g. pistil with disk scales (a–c GEESINK & HIEPKO 7831, d–e HELFER s.n., f–g NGF 30718). After HIEPKO, 1979.

124; BTH. Fl. Austr. 1 (1863) 191; VALET. Crit. Overz. Olacin. (1886) 156; ENGL. in E. & P. Nat. Pfl. Fam. 3, 1 (1889) 241; S<sup>+</sup>EUM. in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 36; HIEPKO, Willdenowia 9 (1979) 43. — *Tsjeru-caniram* RHEEDE [Hort. Mal. 7 (1688) 3, t. 2] *ex* ADANS. Fam. Pl. 2 (1763) 80; PFEIFFER, Nom. 2 (1874) 1501 ('*Tsjerucanirum*'); O.K. Rev. Gen. Pl. 1 (1891) 112 ('*Tsjerucaniram*'); BAILL. Hist. Pl. 11 (1892) 458 (*sub Loranthaceae*). — **Fig. 14, 16, 17.**

Lianas or erect shrubs, root parasites; branches often conspicuously zigzag; twigs densely covered with mostly upcurved hairs. *Leaves* herbaceous to thinly-fleshy or coriaceous, glabrous or hairy. *Flowers* bisexual, in axillary spikes, each flower in the axil of a small persisting bract. Rachis of spike and bracts densely hairy, perianth pilose. *Tepals* united; the urceolate or campanulate perianth with 4, small, recurved lobes, exceptionally 5-lobed. *Stamens* not exceeding the perianth tube; filaments filiform. Disk scales alternating with the stamens. *Ovary* ovoid to cylindric; style short, not or hardly exceeding the perianth tube; stigma capitate,  $\pm$  4-lobed. *Drupe*  $\pm$  ellipsoid, sessile on the lacerated perianth; 1 or 2 drupes per infructescence; mesocarp fleshy-juicy, endocarp thin, brittle. *Embryo* much shorter than the seed, with 3–4 cotyledons.

Distr. 3 spp., from India and Sri Lanka to S. China, *Malesia*, and N. Australia. Fig. 15.

Ecol. In evergreen and deciduous forest, from the lowland up to 1000 m, in S. China up to 1400 m.

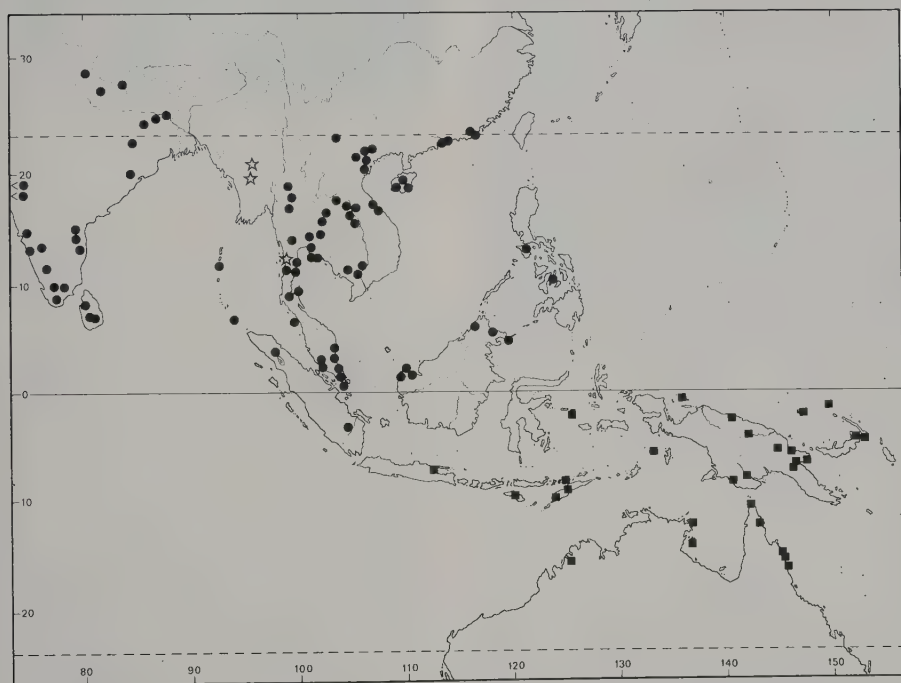


Fig. 15. Range of the genus *Cansjera* Juss.: *C. leptostachya* BTH. (squares), *C. parvifolia* KURZ (stars), *C. rheedii* J.F. GMELIN (dots). After HIEPKO, 1979.

## KEY TO THE SPECIES

1. Leaves ovate to broadly lanceolate (or elliptic),  $\pm$  acuminate. Perianth tube (2-) 2.5-3.5 mm long

1. *C. rheedii*

1. Leaves lanceolate, long-narrowed. Perianth tube c. 1.5 mm long ..... 2. *C. leptostachya*

**1. *Cansjera rheedii*** J.F. GMELIN, Syst. Nat. 2 (1791) 280 (*'Cansiera'*); MEISN. Denkschr. Kön.-Bayer. Bot. Ges. Regensburg 3 (1841) 290; WIGHT, Ic. 5 (1852) t. 1861; BTH. Fl. Hongk. (1861) 296; BRANDIS, For. Fl. India (1874) 75; MAST. Fl. Br. India 1 (1875) 582; KURZ, J. As. Soc. Beng. 45, ii (1876) 123; For. Fl. Burma 1 (1877) 237; VALET. Crit. Overz. Olacin. (1886) 158; TRIM. Fl. Ceyl. 1 (1893) 259; KING, J. As. Soc. Beng. 64, ii (1895) 592; BRANDIS, Indian Trees (1906) 149, f. 69; GAGNEP. Fl. Gén. I.-C. 1 (1911) 809; MERR. Philip. J. Sc. 7 (1912) Bot. 265; GAMBLE, Fl. Pres. Madras (1915) 193; MERR. En. Born. (1921) 242; En. Philip. 2 (1923) 115; PARKINS. For. Fl. Andam. (1923) 125; HAINES, Bot. Bihar Orissa 1 (2) (1925) 191; MERR. Lingn. Sc. J. 5 (1927) 70; CHUN & CHANG, Fl. Hainan. 2 (1965) 458, f. 522; PATEL, For. Fl. Melghat (1968) 70; HIEPKO, Willdenowia 9 (1979) 45. — *C. malabarica* LAMK. (incl. var.  $\beta$ ) Encycl. 3 (1792) 433, *nom. illeg.*; Tabl. Encycl. 2 (1792) 429, pl. 289. — *C. scandens* ROXB. Pl. Corom. 2 (1799) 2, t. 103 (*'Cansiera'*); Fl. Ind. ed. Carey 1 (1832) 441. — *Daphne polystachya* WILLD. Sp. Pl. 2 (1799) 420, *nom. illeg.* — *Daphne monostachya* WILLD. l.c. — *C. lanceolata* BTH. London J. Bot. 1 (1842) 491; M. ROEMER, Syn. Hesper. 1 (1846) 16. — *C. zizyphifolia* GRIFF. Calc. J. Nat. Hist. 4 (1843) 236 (*'Cansiera zizyphifolia'*); Flora 27 (1844) 435; Not. Pl. As. 4 (1854) 360; Ic. Pl. As. 4 (1854) pl. 537; KURZ, For. Fl. Burma 1 (1877) 237; RIDL. Fl. Mal. Pen. 3 (1924) 172; SINCLAIR, Gard. Bull. Sing. 14 (1953) 35. — *C. polystachya* (WILLD.) M. ROEMER, Syn. Hesper. 1 (1846) 144. — *C. monostachya* (WILLD.) M. ROEMER, l.c. 16. — *Olex sumatrana* Miq. Fl. Ind. Bat. Suppl. (1861) 342. — **Fig. 14a-c, 16.**

Liana, climbing up to 8 (-11) m, with hanging branches, or erect shrub with spiny stem. Leaves coriaceous and brittle in dry state, glabrous, ovate to lanceolate or elliptic, (3-) 5-9 (-13) by 1.5-4 (-5) cm; apex  $\pm$  acuminate; base shortly attenuate to attenuate, rarely rounded; midrib and nerves sometimes prominent beneath, nerves 5-7 pairs; petiole 3-5 mm, densely hairy. Spikes 1-3 (-5) in the axil of one leaf, 1.3-2.5 (-4) cm long when flowering; bracts ovate to triangular, acute, 1 mm long. Perianth urceolate, greenish yellow, tube (2-) 2.5-3 mm long, lobes recurved, 0.5 mm. Filaments c. 2 mm; anthers broadly oval, reaching as far as the throat of the perianth tube. Disk scales slightly fleshy, ovate, acute, irregularly toothed, c. 0.75 mm long. Ovary  $\pm$  cylindric, c. 1 mm long; style c. 1 mm,



Fig. 16. *Cansjera rheedii* J.F. GMELIN. Inflorescence and fruit (GEESINK & HIEPKO 7831). Photogr. HIEPKO, Dec. 1974.

long persistent; stigma 4-lobed. *Drupe* orange, 10-13 (-15) by 7-9 (-12) mm. *Seed* with deeply sunken basal hilum; embryo about 1/3 as long as the seed.

Distr. From Nepal, India, and Sri Lanka to S. China and western Malesia: Sumatra (East Coast, Palembang), Malaya (mostly southern half), Borneo (NW. Kalimantan, Sarawak, Sabah), Philippines (Mindoro, Cebu, Sulu Is.). Fig. 15.

Ecol. In deciduous and evergreen forest, often in beach forest, from sea level up to 1000 m, in S. China up to 1400 m. Often on sandy soil. Fl. Jan.-Dec.

Root parasite; roots and haustoria have been studied recently (cf. WEBER, Naturwissenschaften 64, 1977, 640, fig.; HIEPKO & WEBER, Willdenowia 8, 1978, 351-362; WEBER, Beitr. Biol. Pfl. 53, 1978, 371-410; WEBER & HILDENBRAND, Ber. Deut. Bot. Ges. 91, 1978, 231-242).

Vern. Malay Peninsula: *buah champerei*; Sandakan: *tomou*.



Notes. Stem of young shrubs growing in an inclined position, branches spreading. The spines become teat-like through secondary growth (cf. HIEPKO & WEBER, Willdenowia 8, 1978, 356, f. 3).

Form, size, and venation of the leaves are variable. Often a pair of arcuate side-nerves shortly above the base are nearly as strong as the midrib; such 3-nerved forms have been named *C. zizyphifolia*. The flowers are fairly uniform, but the fruits vary in size and form (sometimes more globular).

**2. *Cansjera leptostachya* BTH.** London J. Bot. 2 (1843) 231; M. ROEMER, Syn. Hesper. 1 (1846) 16; MEISN. in DC. Prod. 14 (1857) 519; BTH. Fl. Austr. 1 (1863) 394; HEMSL. Bot. Chall. 1, 3 (1885) 235; VALET. Crit. Overz. Olacin. (1886) 159; WARB. Bot. Jahrb. 13 (1891) 299; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 301; VALET. Bull. Dép. Agric. Ind. Néerl. 10 (1907) 8; SCHELLENB. Bot. Jahrb. 58 (1923) 156; BACK. & BAKH. f. Fl. Java 2 (1965) 67; HIEPKO, Willdenowia 9 (1979) 49. — *C. timorensis* DECNE, Voy. Venus, Bot. (1864) 12 ('*Candjera*'); Atl. (1846) pl. 8; FORBES, Wand. (1885) 502. — Fig. 14f–g, 17.

Liana, up to 6 m, branches hanging, or erect shrub; young twigs puberulous, often soon becoming glabrous. *Leaves* herbaceous in dry state, glabrous, ovate-lanceolate, long-narrowed, 4–9 (–11) by (1–) 1.5–4 cm; apex acute or  $\pm$  acuminate; base attenuate to shortly attenuate; midrib and main lateral nerves rarely somewhat prominent beneath, (6–) 7–9 pairs of mostly inconspicuous nerves; petiole (2–) 4–6 mm, hairy. *Spikes* 1–4 (–5) in the axil of one leaf, (1–) 2–3 cm long when flowering; bracts lanceolate, 0.5–1 mm long. *Perianth* urceolate, greenish yellow or white, tube c. 1.5 mm long, lobes recurved. *Stamens* as long as the perianth tube. Disk scales slightly fleshy, oblong, apex 3-toothed, c. 0.5 mm long. *Ovary* ovoid, c. 1 mm long; style c. 0.5 mm long; stigma shallowly 4-lobed. *Drupe* orange-red, ellipsoid to nearly globular, 11–15 by 9–13 mm.

Distr. Northern Australia; in *Malesia*: New Guinea (incl. Bismarcks), Moluccas (Key and Sula Is.), Lesser Sunda Is. (Sumba, Alor, Timor), and E. Java (Surabaya). Fig. 15.

VALETON (l.c. 1886, 159) mentioned 'Nova Zeelandia', but this is obviously an error for 'Nova Guinea'.

Ecol. In evergreen forest or in semi-deciduous thickets, often climbing on the edge of woods; from sea level up to 700 m; on calcareous rocks (Java) or on sandy soil. According to STAUFFER (in sched.) parasitic on *Leguminosae* and *Sapindaceae*. Fl. Jan.–Dec. Flowers with sweet scent.

Uses. According to DUNLOP c.s. (N. Territ. Bot. Bull. 1, 1976, 59) the fruits are edible.

Vern. Lesser Sunda Is.: *kema rabeti*, Sumba,



Fig. 17. *Cansjera leptostachya* BTH. With the flowering pendent branches. Ifar near Hollandia (Jayapura), W. New Guinea (VAN ROYEN & SLEUMER 6174; photogr. SLEUMER, July 1961).

*kape bila*, Alor; Moluccas: *meô menumpang*, Sula Is.

Note. *Cansjera leptostachya* is undoubtedly closely allied to *C. rheedii*. But since it differs from this species in several floral and vegetative characters (inflorescences more lax, perianth tube clearly shorter; leaves smaller, lanceolate, and more herbaceous; spines never reported) I prefer to maintain *C. leptostachya* as a distinct species.

## Excluded

*Cansjera grossularioides* BLCO, Fl. Filip. (1837) 73 ('*Cansiera*') = *Antidesma ghaesembilla* GAERTN. (*Euphorbiaceae*).

*Cansjera pentandra* BLCO, l.c. = *Antidesma pentandrum* (BLCO) MERR. (*Euphorbiaceae*).

*Cansjera rheedii* BLCO, l.c., non J.F. GMELIN = *Antidesma pentandrum* (BLCO) MERR. (*Euphorbiaceae*).

*Champerea perrottetiana* BAILL. [Adansonia 3 (1862) 125] is doubtless a *Scleropyrum* sp. and probably rightly regarded as *Scleropyrum pentandrum* (DENNST.) MABBERLEY [= *S. wallichianum* (W. & A.) ARN.], *Santalaceae*; cf. BAILLON, Hist. Pl. 11 (1892) 467; HOOK. f. Fl. Br. India 5 (1886) 235.

*Lepionurus pubescens* RIDL. Trans. Linn. Soc. Bot. 9, 1 (1916) 27 = *Scleropyrum aurantiacum* (LAUT. & K. SCH.) PILGER (*Santalaceae*).

## ARISTOLOCHIACEAE (Ding Hou, Leyden)

Perennial herbs, more commonly woody at the base, undershrubs or shrubs, erect, scrambling or scandent, sometimes high lianas. Rhizome not rarely tuberous. Branches often slightly swollen and jointed at nodes. Hairs simple, uni- or multicellular, short ones often with a hooked apex. *Leaves* simple, spiral or alternate, petioled (without an abscission zone), exstipulate; midrib usually prominent beneath, elevated or flat above; nervation commonly palmate, or pinnate, nerves often obliquely extending towards the margin. *Flowers* bisexual, actinomorphic or zygomorphic, solitary, fasciculate, or in axillary or cauligerous, racemose, panicate or cymose inflorescences, usually only one or two flowers open at a time; bracts present and often persistent; pedicel often hardly distinct from the ovary. *Calyx* petaloid, gamosepalous, 3- (or 6-) lobed or 1-lipped; lobes valvate or induplicate. *Petals* (in Mal.) absent. *Disk* (?) 0, rarely present (e.g. a few *Thottea* spp.). *Stamens* 6 (4 or 5 in some extra-Mal. *Aristolochia* spp.) or 6—c. 36 (—46), in 1 whorl or in 2 (3 or 4) whorls (*Thottea*); filaments free or slightly mutually united at the base, and/or almost completely adnate to the style column to form a gynostemium; anthers free (*Thottea*) or dorsally united with the style column (*Aristolochia*), each consisting of 2 thecae with 4 pollen sacs, extrorse, rarely introrse (extra-Mal. spp.), dehiscent longitudinally. *Ovary* inferior (rarely half-inferior in extra-Mal. genera), 4—6-carpellate, 4—6-celled, syncarpous (or  $\pm$  apocarpous in extra-Mal. *Saruma*); placentae parietal (distinct when young, then intruding and connivent axially, thus often seemingly axile); ovules usually many, anatropous, in 1 or 2 vertical rows in each locule of the ovary, horizontal or pendulous; style-column 3—many-lobed, sometimes some of the lobes redivided; stigmas or stigmatic tissue apical, lateral, or on the surface of style lobes. *Fruits* capsular or siliquiform (follicular or cocci in extra-Mal. genera), 4—6-celled; dehiscent apically towards the base (basipetal, e.g. *Thottea*) or basally towards the apex (acropetal, e.g. most *Aristolochia*); septicial, rarely septifragal (some extra-Mal. *Aristolochia*) or bursting irregularly (extra-Mal. *Asarum*); rarely indehiscent (W. African *Pararistolochia*). Seeds many in each locule (1-seeded in extra-Mal. *Euglypha*), often coated with remains of placental tissue (membranous when dry), horizontal or pendulous, variously shaped; ovate, deltoid or triangular, flat, convex-concave, or longitudinally curved, or oblong (and triangular in cross-section), rugose, finely verrucose, or smooth, immarginate (*Thottea*; *Aristolochia*, p.p.) or winged (*Aristolochia*, p.p.); albumen fleshy, copious; embryo minute, cotyledons two, distinct.

**Distribution.** There are 7 genera, *Aristolochia* worldwide, *Asarum* over the northern hemisphere, *Thottea* in continental Southeast Asia and Malesia, *Pararistolochia* in tropical Africa, and 3 monotypic genera, viz. *Saruma* in China, *Holostylis* and *Euglypha* in South America. As to number of species, *Aristolochia* is by far the largest with some 300 spp., largely concentrated in the New World, especially in Central and South America, in Malesia with 28 spp.; *Asarum* (incl. *Hexastylis* and *Heterotropis*) with possibly some 70 spp. in northern temperate regions, *Thottea* with 26 spp., of which 22 in Malesia, and *Pararistolochia* with 12 spp. in West Africa.



**Ecology.** In Malesia *Aristolochiaceae* occur mostly locally, often sporadic, exceptions being *Thottea tomentosa* which may be a locally common undershrub and *Aristolochia tagala* which is often a common slender twiner in thickets. Usually the species are confined to the primary forest, from the lowland to montane stations, in various forest types, dryland and swampy forest, on limestone, in secondary forest and bamboo groves, only a few species ascending to 1500–2250 m altitude.

*Aristolochiaceae* as host plants for butterflies. Certain groups of *Papilionidae* are bound to *Aristolochiaceae* as a host plant and this is true of Malesian *Aristolochia* and *Thottea*. EHRlich & RAVEN (1964) have made a survey and found that in the family *Papilionidae*, the swallow tail butterflies having 3 subfamilies, the holarctic and oriental subfamily *Parnassiinae* with 5 genera, feed only on *Aristolochiaceae*. In the tropical worldwide subfamily *Papilioninae* with 3 tribes, the tribe *Troidini* is almost confined to *Aristolochiaceae* as host plant. The bond between the butterflies and their host may be different, some are monophagous, others are oligophagous (feeding on a few species) and still others are polyphagous.

Obviously there is a choice, coinciding with the taxonomy of the butterflies and the phytochemistry of the host plants. EHRlich & RAVEN use the term 'co-evolution' in this respect, but it should be pointed out that in this case the benefit is only for the butterflies (*i.e.* their larvae); they do not serve in pollination; in proper co-evolution both parties are interdependent.

It is found by entomologists that the female butterflies are attracted by the scent of the plant to lay their eggs. The evolving caterpillars feed on the host and in the herbarium one may find traces of this, in the way of leaf perforations or erose leaf margins; the larvae also feed on new shoots and buds. Pupae are generally found near the base of the stem of the host, and that is in some very large rain-forest lianas far away from the foliage of the host.

Several entomologists have published on the relations of *Aristolochiaceae* and butterflies in Malesia, *e.g.* STRAATMAN (on N. Sumatra, SE. New Guinea, Queensland, and the Solomons), IGARASHI (on the Philippines and New Guinea), while HAUGUM listed them from the Papuan region. I gave a summary (1983) and JACOBS a review (1982).

**Literature:** EHRlich & RAVEN, *Evolution* 18 (1964) 586–608; HAUGUM, *The Lepidoptera group of 1968, Newsletter* 2 (1981) 171–184; DING HOU, *Blumea* 29 (1983) 223–249; IGARASHI, *Food plants of Papilionidae* (1979); JACOBS, *Fl. Males. Bull.* 35 (1982) 3747–3749; STRAATMAN & NIEUWENHUIS, *Tijdschr. Entom.* 104 (1961) 31–41; J. Lep. Soc. 16 (1962) 99–103; *ibid.* 23 (1969) 69–76; *ibid.* 25 (1971) 58–64.

**Pollination.** Already two centuries ago SPRENGEL suggested insect pollination in *Aristolochia* and a century ago HILDEBRAND found the flowers proterogynous and concluded to cross-pollination. As a matter of fact the flowers represent a beautiful trap with a 'slide zone' on the limb above the tube which is inside usually provided with retrorse hairs preventing insects to leave during anthesis. They are trapped in the utricle which provides them with nectar and usually also other food substance of glands. BAKER *c.s.* (1973) added that also stigmatic secretions containing amino-acids would add to the nutritional potential in the utricle. The insects, mostly flies, sometimes also ants, are attracted to the flowers by the putrescent odour, sometimes an offensive smell of decaying meat, emitted during anthesis by the flower or its stalk, and this occurs also in other genera of the family. PETCH (1924) found that some species are visited by only one kind of fly, but in other species he found up to 13 different kinds; the two native Ceylon species were visited by one kind of fly only. In some intricate-built flowers of South American species insects are guided to the sexual organs by a window-pane in the utricle. After the flower withers, and the hairs have lost turgescence, the insects can crawl out, loaded with pollen and can visit another flower, leading to cross-pollination.

This is only a generalization, as it appears from the very large study by PETCH (1924) that there is a great variability among the species: mostly flowers open at daybreak or shortly before and wither after 24 hours, but there are species which show a second-day revival; some have no food bodies; in some species the tube is wide and flies can easily escape; in other species the tube has

no hinged hairs. For that reason one cannot give a single answer to whether cross-pollination is necessary for the setting of the fruit in all species.

BURCK (1890, 1892) made extensive experiments, including bagging flowers *etc.*, on three exotic species in the Botanic Gardens at Bogor (*viz.* *Aristolochia barbata*, *A. elegans* and *A. ornithocephala* = *A. brasiliensis*) and concluded that they are autogamous. PETCH (1924) studied in detail some dozen species at Peradeniya in Ceylon and concluded that, 'although *Aristolochias* are adapted for cross-fertilization, some species can be self-fertilised. It is evident that all grades of self-fertility or self-sterility may be expected within the genus.'

Observations on pollination in *Thottea* are very scant; its flowers are regular and open and do not offer a complicated structure as in *Aristolochia*. They emit also a putrid smell, are mostly dark-coloured and their flower is also protogynous, as BACKER (1918) observed in *Apama tomentosa* at Bogor. He stated that this species propagates very well vegetatively by stooling and that very few fruits are produced, both in cultivation and in the field in bamboo groves at Depok. BACKER observed flies visiting the flowers; he hypothesized that cross-pollination might be possible during the transition period from the female to the male stage. As a matter of fact I found (1981) the styles or style-lobes (with their stigmas or stigmatic surfaces) reflexed or twisted at anthesis, facilitating contact with pollen grains, which I found germinated in flowers of *Thottea triserialis*. Self-pollination and fertilisation may hence also occur in *Thottea*.

For *Asarum* reports also vary and both self-pollination and cross-pollination by flies or fungus gnats seem to occur (VOGEL, 1978).

*Literature:* BACKER, Trop. Natuur 7 (1918) 177–183, 4 fig. (on *Apama*); *ibid.* 8 (1919) 133–138, 150–155, 161–168, fig. 5–15; H.G. BAKER c.s. in Brantjes (ed.), Pollination and dispersal (1973) 47–60; BURCK, Ann. Jard. Bot. Btzg 8 (1890) 149–157, t. 23; Bot. Zeit. 50 (1892) 121–129, 137–144, t. 3; CAMMERLOHER, Oest. Bot. Z. 72 (1923) 180–198; t. 5–6; DING HOU, Blumea 27 (1981) 314; *ibid.* 29 (1983) 223–249; LEEMAN, Bull. Soc. Bot. Genève 19 (1927) 149–159, fig. 98–107; K.L. LU, Syst. Bot. 7 (1982) 150–157, t. 1–3 (both on *Asarum*); PETCH, Ann. R. Bot. Gard. Perad. 8 (1924) 1–108, t. 1–5; PFEIFER, Ann. Mo. Bot. Gard. 53 (1966) 119–120; S. VOGEL, Flora 167 (1978) 329–366, fig. 1–12.

*Morphology. Habit.* In Malesia there are two main habit types: 1) perennial herbs which are often woody at the base; they are either a) erect undershrubs or shrub-like, up to 3 m high, sometimes slightly higher as in most species of *Thottea* and some of *Aristolochia* (e.g. *A. humilis*, *A. macgregorii*, *A. sericea*, *etc.*) or b) spreading, scrambling or twining up to several metres high, as in *Thottea corymbosa* and some species of *Aristolochia* (e.g., *A. glaucifolia*, *A. jackii*, *A. linne-mannii*, *A. minutiflora*, *etc.*); and 2) woody twiners or high lianas from a few metres up to c. 50 m high, with an old stem up to 2 (–4) cm  $\phi$  (most species of *Aristolochia*).

In absence of field data on the habit (erect or climbing) sterile specimens can hardly be identified to the genus (*Aristolochia* or *Thottea*). Sterile specimens of erect plants can be discriminated if they are sufficiently ample; see the paragraph 'leaf architecture' under *Thottea*.

As to the direction of twining, I do not know whether it is constant for the species of *Aristolochia*. I observed that plants of *A. tagala*, *A. ringens* and *A. foveolata* germinated from seeds and, growing in my office, appear to have no definite direction to twist and may go either right or left as stated by MENNINGER (Flowering vines of the world, 1970, 91–99, phot. 42–45).

Lianas of *Artistolochia* twining on high trees bear leaves often at the top and flowers and/or fruits at the lower part of the stem. Occasionally only 'leafless' fertile herbarium specimens were available because the leaves were difficult to locate or to collect.

*Roots and rootstocks.* The roots, sometimes also root-like tubers, of (some) *Aristolochia* are fleshy, sometimes with bitter taste, and of various shapes (e.g. globose, ovoid, cylindric, fusiform, turnip-shaped, *etc.*), which are characteristic for some species. They have sometimes been collected, recorded and used for species delimitation (*cf.* DAVIS & KHAN, Notes R. Bot. Gard. Edinb. 23, 1961, 515–546; LIANG, Acta Phytotax. Sinica 13, 1975, 10–28; CHOW & HWANG, *l.c.* 108–109). From Malesia nothing is known about root structure.



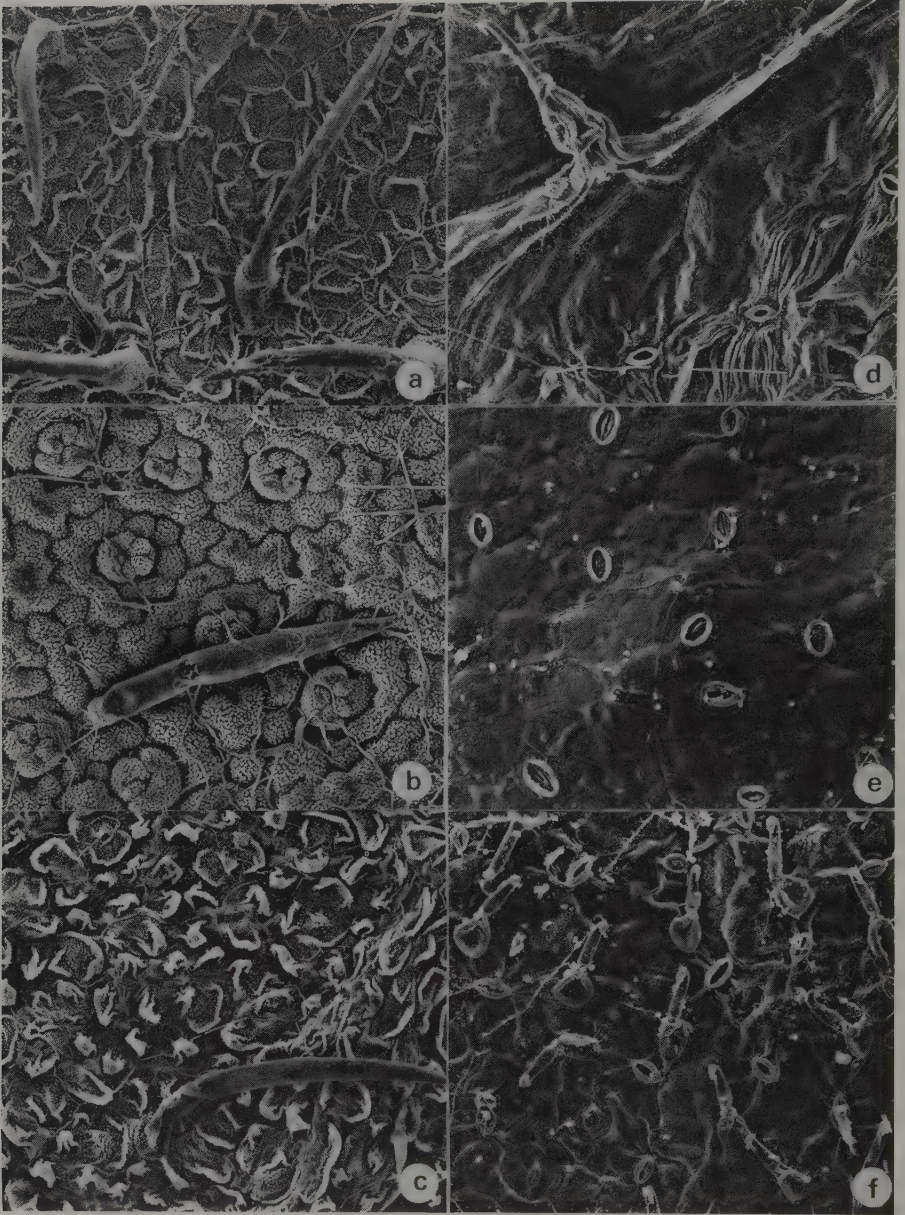


Fig. 1. Scanning electron micrographs showing features of leaf undersurfaces. — *a–c. Thottea*: *a. T. corymbosa* (GRIFF.) DING HOU, *b. T. dependens* (PLANCH.) KLOTZSCH, *c. T. muluensis* DING HOU. — *d–f. Aristolochia*: *d. A. macgregorii* MERR., *e. A. gaudichaudii* DUCHARTRE, *f. A. tagala* CHAMISSO. All  $\times 270$  (*a* & *c* hairs and mostly curved or hooked thickenings, *b* hair and ring- or loop-shaped papillae, *d* hooked hair and stomata with striae, *e* glabrous surface and scattered stomata with raised rim, *f* scattered hooked hairs and stomata with raised rim) (*a* CARRICK 1489, *b* SIDEK BIN KIAH 295, *c* ARGENT c.s. 760, *d* BARTLETT 15090, *e* BW 11439, *f* WEBER 1074).



The recumbent rootstocks or rhizomes of *Thottea* and some *Aristolochia* species develop offshoots or runners, which sprawl on the ground or produce erect stems. When the motherplant dies, these stems become free and grow on as separate individual plants, a method of vegetative propagation.

The stems of woody vines of *Aristolochia* are mostly terete, or sometimes slightly flattened (fig. 16), and are up to 4 cm or more in diameter. The bark of the old stems is corky and is often longitudinally fissured or prominently ridged or sometimes rather smooth.

On a cross-section one can observe, by using a handlens, conspicuous anatomical features of the *Aristolochiaceae*: the vascular bundles are arranged in a ring and widely separated from one another by the broad medullary rays. On the cross-section of a rather flattened stem, where the cambium is more active towards two opposite directions, the vascular bundles elongate accordingly and the whole section appears like the numeral '8' (cf. METCALFE & CHALK, *Anatomy of Dicotyledons* 2, 1965, 1114, 1117, f. 237, 268; PONCY, *Adansonia* 17, 1978, 466, 476, f. 1).

The '8'-shaped appearance of the cross-section of the stem has been used as one of the generic characters for separating the tropical African *Pararistolochia* from *Aristolochia* (with circular stem) (cf. PONCY, *l.c.*). In Malesia old stems of *Aristolochia decandra* and *A. coadunata* are sometimes also flattened. Fig. 16.

*Leaves.* Leaves of *Aristolochiaceae* can provide useful characters especially for identification of sterile collections. Fig. 1, 8. However, in some species, they are heteromorphic or very variable in shape, size, texture, etc.; they vary sometimes also between those of fertile and vegetative branches, apical and lower parts of a (high) woody vine, juvenile and adult stages, etc. (e.g. in *Aristolochia dielsiana*, *A. tagala*, *A. zollingeriana*; *Thottea tomentosa*).

The leaves of Malesian *Aristolochia* vary in size; the largest known to me occur in *A. dielsiana* measuring up to 37 by 23 cm; according to R. STRAATMAN they can reach to 100 by 70 cm.

The leaves are usually distinctly petioled. The petiole is often more than 2 cm long, sometimes up to 13 cm; it is very short only in a few species, e.g., *Aristolochia macgregorii* (c. 3 mm), *A. sericea* (2–5 mm). In *Thottea* petioles are usually short.

The leaf does not possess an abscission zone either on the petiole or at its base. The old or dried leaf just hangs on the plant for some time and then breaks irregularly from the petiole, leaving no scar on the stem. This is very characteristic for the species of this family.

The undersurface of the leaf has interesting sculpture features or ornamentation, e.g. hair types or density of hairs, cuticular thickenings or markings, protuberances of epidermal cells, etc., which are useful as diagnostic characters, especially for identification of sterile collections (cf. Blumea 27, 1981, 310–311, f. 5–33). Fig. 1. For example, *Thottea dependens* has papillae forming rings or curves (fig. 1b), *T. muluensis*, *T. pennilobata*, and a few others show crescent, curved or hooked thickenings (fig. 1c), *Aristolochia macgregorii* has stomata with extended striae of thickenings (fig. 1d). Such characters can easily be examined under a normal binocular with a magnification up to about  $\times 60$ ; sometimes they can even be observed with a handlens.

Also the venation types are often characteristic; the main ones are illustrated in fig. 8.

*Series of axillary buds.* In some species of *Thottea* and *Aristolochia* sometimes 2 or 3 (–5) buds occur in a leaf axil, especially in the terminal one. These buds may develop into flowering and/or vegetative branches, e.g. in *Thottea corymbosa*, *Aristolochia sericea*, *A. gaudichaudii*, etc. (cf. SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b, 1935, 210–211, f. 106; DELAIGUE, Soc. Bot. Fr., Mém. 1971, 167–177, f. 1–6).

*Flowers.* The flower in *Aristolochiaceae* is probably essentially provided with a calyx and a corolla, but the latter is almost always suppressed. It is still present in the monotypic Chinese genus *Saruma* which is assumed to be the most primitive of the family. It is also found as 3 rudimentary, subulate segments in *Asarum canadense*, as a relict feature.

Flowers are very important for species delimitation. Unfortunately, for many Malesian species flowering material is scanty in the herbarium. Some tropical species of *Aristolochia* have rather large flowers, the largest being the neotropical *A. grandiflora* Sw., with a limb up to 50 cm wide

and a total flower length up to 3 m, a serious competitor of *Rafflesia* which is mostly held as the largest flower in the world. In contrast with this, *Aristolochia* flowers have often a thin, delicate texture difficult to handle in dried material.

The flowers in *Aristolochia* open only one or two, or a few at a time. The flowering duration is often very short, one to a few days. They are sometimes deformed after pressing and drying. The flowers of *Aristolochia* deliquesce sometimes rapidly; they also fall and decay quickly following pollination and fertilization (cf. PFEIFER, Ann. Mo. Bot. Gard. 53, 1966, 119).

The flowers are bisexual; they emerge terminally or laterally in the axils of leaves or bracts, and/or cauligerous; they are solitary, fasciculate, or arranged in cymes, racemes or panicles. The flowering branches or rachides are sometimes with spacious internodes (e.g., *Aristolochia jackii*, *A. schlechteri*) or strongly reduced with internodes hardly visible (e.g., *A. crassinervia*, *A. sericea*). The flowers are pedicelled. There is often hardly any external distinction visible between the pedicel and the ovary; they have been treated here as one unit.

The perianth or calyx is 3-lobed and actinomorphic in *Thottea*. In *Aristolochia* it is rather specialized and usually zygomorphic; it consists of three (sometimes not sharply separated) parts: utricle, tube and limb. Between the perianth and the ovary, there is often a constriction or articulation, sometimes with a lobed rim where the perianth breaks off from the fruit.

The utricle is the basal inflated part of the perianth. It is often globose, subglobose, ellipsoid, ovoid or obovoid. On the inner surface of the utricle, there are usually two symmetrically placed glandular, usually ellipsoid swellings at the apical part. They are food bodies, composed of dense glandular hairs, serving for imprisoned insects (cf. PETCH, Ann. R. Bot. Gard. Perad. 8, 1924, 28). Sometimes there are two small bosses or depressions shown on the outer surface corresponding to the position of the food bodies inside (cf. CURTIS' Bot. Mag. t. 7429). Some Malesian species have six such glandular food bodies (e.g., *Aristolochia foveolata*, *A. papillifolia*). The distal end of the utricle is gradually or abruptly narrowed into a cylindric tube which may be straight or curved. The base of the 'tube', specially in some extra-Malesian species, slightly elongates and projects into the utricular cavity; the flange-like part inside the cavity has been called syrx (cf. PFEIFER, Ann. Mo. Bot. Gard. 53, 1966, 116, f. 1). The tube gradually or abruptly and slightly enlarges its size at the apical part and merges with the expanded limb. For the diameter of the tube, only the cylindric, middle part has been taken.

The limb is 1-lipped (in many species), sometimes distinctly 3-lobed (e.g., *Aristolochia decandra*, *A. momandul*), occasionally rim-like and obscurely 3-lobed (*A. coadunata*), or rarely 6-lobed (*A. schlechteri*).

The colour of the perianth appears sometimes to vary with the developing stage of the flower, as recorded in field notes. It is characteristic in some species. Unfortunately, I could not use it in keys, because it has only erratically been recorded in field notes.

*Perianth of Aristolochia.* As mentioned above, the perianth of *Aristolochia* should be regarded as homologous with a calyx and of course be homologous with the perianth in other genera of the family (e.g. *Asarum*, *Thottea*). In several species it is also 3-lobed, but in many others it is entire. Some authors have, however, a different opinion about its morphological derivation.

LORCH (Evolution 13, 1959, 415–416, f. 1) observed a shoot of *Aristolochia maurorum* bearing a series of teratological leaves and proposed a new interpretation of the perianth of this genus. He stated that 'the perianth is the metamorphosed first leaf of a lateral branch' and '... agrees in form with an involute normal foliage leaf.'

HAGERUP (Bull. Res. Council Israel 10, sect. D, 1961, 348–351, f. 1–14) studied both the venation and the development of the leaf and the perianth of *Aristolochia* (especially *A. elegans*). He concluded that 'The perianth is *not* compounded of several united leaves but consists of only a single leaf (like the spathe of the *Araceae*).'

GUÉDÈS (Flora, ser. B, 158, 1968, 167–179, f. 1–5) and TIONG CHUI HUONG (Morph. and taxon. studies on some Aristolochiaceae plants in Singapore, 1979/80, 43–45, not published) made comparative, morphological studies on the vegetative leaf and the perianth of *Aristolochia* (e.g.,

*A. clematitis*, *A. grandiflora*, *A. peltata*). Their results confirmed the interpretation and findings of LORCH and HAGERUP.

It should be remarked that the *Aristolochia* species, studied morphologically and anatomically by the three authors all possess a 1-lipped perianth. Their thesis should be tested for species in which the limb is rim-like or obscurely 3-lobed (e.g. *A. coadunata*, *A. griffithii*), or distinctly 3-lobed (e.g. the tropical West African species of *Pararistolochia*; and *A. decandra*, *A. momandul*), and the 6-lobed species *A. schlechteri*.

*Stamens and styles*. The number and arrangement of the stamens in *Thottea* show an interesting series of reduction. Fig. 4–7. The stamens in this genus range from 36 (–46) (e.g. *T. grandiflora*) to as few as 6 (e.g. *T. tomentosa*); they are from free and arranged in 4 series (*T. parviflora*), through partly free and in 3 (*T. triserialis*) or 2 series (most of the species), to united with the style column and just in 1 series (several species, e.g. *T. corymbosa*).

In *Aristolochia* the stamens are adnate to the style column to form a gynostemium. All Malesian species have 6 stamens, except *A. decandra* which has 10. Fig. 15. Each anther consists of two thecae with four microsporangia (pollen sacs) (cf. JOHRI & BHATNAGAR, Phytomorphology 5, 1955, 124–125, f. 8, 44–47; NAIR & NARAYANAN, Lloydia 24, 1961, 199–200, f. 1–3). The thecae of a stamen are in some *Aristolochia* species (e.g. *A. jackii*) separated from each other by a rather broad connective.

The styles appear to be free in *Thottea parviflora*. They are united with the stamens into a short column (gynostemium) in all other species of *Thottea* and *Aristolochia*. The style column may be discoid or obtuse at apex and then divides, or sometimes redivides, into a number of slender or finger-like lobes. The number of styles or style lobes varies in species of *Thottea* from c. 20 (e.g. *T. macrophylla*) to only 2 or 3 (e.g. *T. paucifida*; fig. 5). In Malesian *Aristolochia* the style has 6 lobes (except 3 in *A. coadunata* and 10 in *A. decandra*).

The lobes of style column (or gynostemium) are glabrous (often sticky when fresh) or sometimes (densely) hairy (covered with hooked and/or straight hairs or papillae). In *Thottea*, they are erect or spreading when young and often reflexed or irregularly twisted at anthesis (cf. DING HOU, Blumea 27, 1981, 311–314, f. 38–50).

In *Aristolochia*, changes occur in the structure and shape of the style lobes at anthesis. When young, they are distinctly separate from one another. At first the style lobes may be rather thin with longitudinally reflexed margins and their basal parts covering the apices of the unopened anthers. At anthesis, the style lobes slightly swell, flatten, and become erect and adherent; their apical parts bend inward, and the anthers become exposed. The lobes form then almost a funnel; their apical parts and inner surfaces have a rather thick layer of slime (cf. BACKER, Trop. Natuur 8, 1919, 134–136, f. 1–4; PFEIFER, Tax. rev. pentand. sp. *Aristolochia*, 1970, 8–9, f. 1).

In herbarium specimens of both *Aristolochia* and *Thottea* I observed that the style lobes are sometimes covered with pollen grains which even may have germinated. These lobes certainly possess stigmatic surface. However, some botanists assume that the lobes are not true stigmas, and that the connectives of the anthers have assumed stigmatic functions (cf. BURCK, Ann. Jard. Bot. Btzig 8, 1890, 151–153, f. 4–8; WILLIS, Dict. Fl. Pl. Ferns, rev. by AIRY SHAW, 8th ed., 1973, 92). This idea seems a bit far-fetched, as for example *Aristolochia coadunata* has only 3 style lobes, but the usual 6 stamens. Also in *Thottea* the number of stigmatic lobes does not correspond with the number of stamens; in *T. tomentosa*, with 6 stamens the number of lobes is 3 or 4.

*Ovary and placentation*. The ovary is inferior (but half inferior in extra-Malesian monotypic *Saruma* and some species of *Asarum*). It is linear, cylindric or fusiform, and is 4- to 6-carpellate and syncarpous (apocarpous in *Saruma*).

The placentas are parietal when young and gradually become imperfectly 4–6-celled. Whenever I dissected a flower, I observed that the placentation appears to be axile. The pseudo-axile appearance is due to intrusion and fusion of the placental partitions in later stages (cf. LEEMANN, Bull. Soc. Bot. Genève 19, 1927, 140–146, f. 82–92; JOHRI & BHATNAGAR, Phytomorphology 5, 1955, 123–124, f. 1–7).



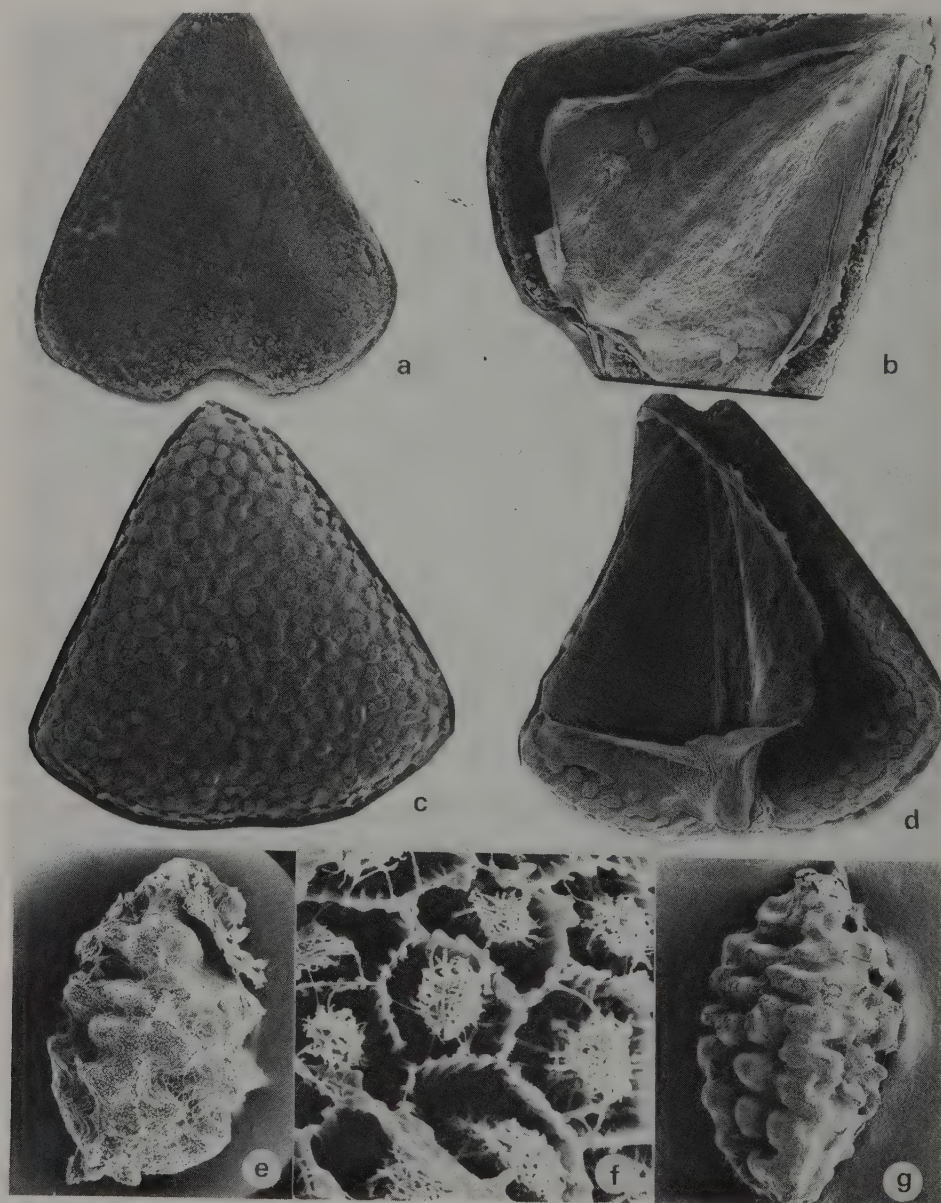


Fig. 2. Scanning electron micrographs of seeds. — *a–d. Aristolochia*: *A. transtillifera* DING HOU, *a*, undersurface, showing testa with finely granulate thickenings,  $\times 12$ , *b*, upper surface, showing the funicle with laterally dilated extension flattened against the seed,  $\times 15$ ; *A. philippinensis* WARB., *c*, undersurface, showing testa with rather coarse, wart-like thickenings,  $\times 15$ , *d*, upper surface, showing the funicle with laterally dilated extension covering the seed,  $\times 15$ . — *e–g. Thottea*: *T. macrantha* (BOERL.) DING HOU, *e*, seed with coating tissue partially peeled off,  $\times 20$ , *f*, surface view of the testa, with periclinal walls peeled off, showing a bundle of fibrous thickenings in each cell lumen,  $\times 700$ ; *T. reniloba* DING HOU, *g*, seed with tuberculate testa, coated with dried, membranous tissue,  $\times 21$  (*a* & *b* SAN 19008, *c* & *d* PNH 10592, *e* & *f* LÖRZING 12434, *g* DE WILDE & DE WILDE-DUYFJES 18829).

The ovules are anatropous and bitegmic (cf. JOHRI & BHATNAGAR, *l.c.* 128–132, f. 48–54; NAIR & NARAYANAN, *Lloydia* 24, 1961, 200–201, f. 11–15). They are usually numerous and are horizontally or pendulously superposed in one or two series in each locule of the ovary.

**Fruits and seeds.** Fruits and seeds are very characteristic for the *Aristolochiaceae*. The fruits are usually capsular (e.g. *Aristolochia*; fig. 17) or siliquiform (*Thottea*; fig. 4) (but follicular in the extra-Malesian *Saruma* and cocci in *Euglypha*). They are 4–6-loculed, usually dehiscent, septicidal, acropetal (and the opened, hanging fruit basket-like as characteristic in *Aristolochia*; fig. 17), or basipetal. They are indehiscent in the tropical African *Pararistolochia* and possibly also in the New Guinean *Aristolochia dielsiana* (see there). They are usually glabrous or rarely hairy (*Thottea*) (cf. SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b, 1935, 220–222, f. 116–117).

The size of the fruits is very variable: in Malesian representatives: the length ranges from c. 1 cm (e.g. *Aristolochia sericea*) to 20 (–38) cm (e.g. *A. dielsiana*; *Thottea tricornis*) and the width from c. 0.5 cm (*Thottea*) to c. 4 cm (*Aristolochia*).

The fruit wall is often slightly lignified (but strongly lignified in *Pararistolochia* and some *Aristolochia* species). The valves of the capsules in *Aristolochia* can sometimes easily be separated in epi-, meso- and endocarp.

The seeds are usually numerous, horizontally or pendulously superposed, and immersed in the spongy cellular tissue in each locule of the capsules (but only one seed developed in extra-Mal. *Euglypha*). They may be divided into two main types according to their general appearance: 1) compressed and flat (*Aristolochia*, *Asarum* and *Holostylis*) and 2) oblong, fusiform, or broadly ovoid, obscurely or distinctly triangular (*Thottea*). Fig. 2. However, the flat seeds sometimes may be longitudinally slightly or strongly concave (e.g. *Aristolochia singalagensis*; *Thottea curvisemen* and *Thottea sp.*).

The seeds are not winged or with a rim-like or marginal wing (*Aristolochia*). They are often slightly or prominently transversely corrugate or rugose (*Thottea*) and are smooth or warty on the testa (*Aristolochia*). The irregular surface of the testa in *Aristolochia* is due to unequal divisions and outgrowth of the epidermal cells (cf. JOHRI & BHATNAGAR, *Phytomorphology* 5, 1955, 133, f. 90–91).

In *Aristolochia* the seeds in many species have an almost unique feature in that the large funicle is rather fleshy, thick, dilated laterally, flattened against the upper surface of the seed and generally larger than it (JOHRI & BHATNAGAR, *l.c.*; CORNER, *Seeds Dicot.* 1, 1976, 73–74; *ibid.* 2, 1976, f. 27–29). This fleshy funicle is equivalent to an elaiosome and is important in seed dispersal. In the dry state it becomes almost membranous and usually covers the seed (fig. 2b, d).

In *Thottea*, after the coating membranous tissue is removed, the testa cells appear as reticulations or papillae; each of these cells has a strong thickening projecting into the cell lumen. If the soft tissue of the testa has been removed or brushed off, one can easily observe the two layers of crossed fibres of the tegument (cf. SOLEREDER, *Bot. Jahrb.* 10, 1889, 504–507, t. 13, f. 19–21; JOHRI & BHATNAGAR, *Phytomorphology* 5, 1955, 133–137, f. 83–95; CORNER, *Seeds Dicot. l.c.*; DING HOU, *Blumea* 27, 1981, 314–315, f. 51–69). Fig. 2e–g.

According to CORNER (*l.c.*) the attachment of the integument along the course of the raphe and the development of two layers of crossed fibres in the tegument forming the mechanical layer of the seed coat are the chief characters of the seeds in *Aristolochiaceae*. He also stated that the tegument of *Caricaceae* seems strikingly similar to the one of this family in having the same set of crossed fibres.

The endosperm of the seeds in *Aristolochiaceae* is copious and fleshy. The embryo is minute with two distinct cotyledons and is enclosed in the endosperm close to the hilum (cf. JOHRI & BHATNAGAR, *l.c.*).

**Seed germination and seedlings.** The seed germination of some species of *Aristolochia* and *Asarum* (*s.l.*) has been reported as epigeal, with the cotyledons spreading above the ground.

In *Aristolochia*, during germination, the radicle protrudes through the hilum or near it or through the testa. The cotyledons are rather fleshy, suborbicular or broad-ovate, with simple



venation (midrib with a few lateral nerves or veins). The first two leaves are opposite; they develop from almost the same plane as the cotyledons and are at right angles with them. The foliage leaves, following the first pair mentioned above, are scattered (*cf.* LUBBOCK, Contribution to our knowledge of seedlings 2, 1892, 444–446, f. 624; TIONG CHUI HUONG, Morph. and taxon. studies on some Aristolochiaceae pl. in Singapore, 1980, 27–28, pl. 4 & 5, f. 4 & 5, not published).

*Seed dispersal.* The winged seed of some *Aristolochia* species may help in dispersal. More important seems the elaiosome (fleshy funicle) which is probably attractive to ants.

*Anatomy* (for oil cells, silicified cells and crystals see under Phytochemistry). METCALFE & CHALK (1950) provided a general survey of the vegetative anatomy of the family: hairs simple unicellular or uniseriate and/or with a hooked terminal cell with silicified tip ('bracket hairs'). Stomata usually anomocytic. Stems typically with broad medullary rays. Secondary phloem occasionally with stone cells but devoid of fibres. Wood with very wide vessels in climbers, but rather narrow ones in erect species. Vessels with simple perforations and coarse pits. Fibres with bordered pits (especially conspicuous in *Aristolochia*). Parenchyma paratracheal, often scanty. Rays mostly wide and forming broad interfascicular bands, but narrow (up to 3-seriate) in some species of *Apama* (= *Thottea*), heterocellular. GUÉDÈS (1968) described the petiole anatomy of some *Aristolochia* species; ALEYKUTTY & INAMDAR (1980) provided detailed accounts of hair types in the family; PHILIP (1983) reported on the diverse ontogeny of the stomatal complex in species of *Aristolochia* and on the predominance of paracytic stomata in *Aristolochia leuconeura*.

Vegetative anatomy is in agreement with the view that *Aristolochiaceae* are related to the *Magnoliales*.

*Literature:* ALEYKUTTY & INAMDAR, Fedde, Rep. 91 (1980) 95–108; GUÉDÈS, Flora, Jena 158B (1968) 167–179; METCALFE & CHALK, Anatomy of the Dicotyledons II, Oxford (1950); PHILIP, Curr. Sci. 52 (1983) 223–224. — P. BAAS.

*Palynology.* The pollen of *Aristolochiaceae* varies in size between 27  $\mu\text{m}$  in *Saruma henryi* and 73  $\mu\text{m}$  in *Aristolochia grandiflora* and is generally spherical-suboblate or ellipsoidal. Two main types can be recognized, the first of which is restricted to *Saruma*. This genus has monocolpate, reticulate pollen which is rather primitive and similar to the basic type found in *Chloranthaceae*, *Annonaceae* and in many monocotyledons. The second, more derived type found in the remaining genera is characterized both by a variable aperture configuration and exine structure.

In *Aristolochia* the pollen grains are inaperturate, indistinctly monocolpate or periporate and the exine may be psilate, scabrate, echinate or areolate. *Pararistolochia* has an indistinctly outlined distal aperture and differs from the preceding genus mainly in its rugulate-areolate exine. The pollen of *Asarum* is inaperturate or irregularly pericollate-periporate and this variation may even occur in a single species (*Asarum virginicum*). The exine has separated verrucae.

*Thottea* pollen is generally inaperturate, but indistinctly monocolpate or periporate grains have been reported also. The exine is verrucate-areolate. In *T. paucifida* the areolae are hardly developed, while in *T. dependens*, *T. dinghoui*, *T. macrantha*, *T. tomentosa* and *T. tricornis* the areolae are widely spaced, thin-walled and not centrally supported by columellae. The intervening exine here is tectate-columellate. Densely spaced areolae are found in *T. grandiflora* and *T. parviflora* and in these species the columellae are reduced to the margins of thin-walled areolae. In the former species the areolae are perforated by rather large holes. *T. corymbosa* is deviating in the larger, rather densely spaced areolae which are finely perforated and supported by rather densely spaced columellae.

With the exception of *Saruma*, the genera of *Aristolochiaceae* cannot be separated on pollen morphological characters, although some species may be distinct. The comparatively primitive *Saruma* pollen type indicates that the taxonomic relations of the family are with *Magnoliales*.

*Literature:* G. ERDTMAN, Pollen morphology and plant taxonomy, Angiosperms (1952) 61–62; D. LOBREAU-CALLEN, Adansonia 17 (1978) 470–472; J.W. WALKER, Amer. J. Bot. 61 (1974) 1112–1137; Linn. Soc. Symp. Series 1 (1976) 251–308. — J. MULLER.

*Phytochemistry.* The chemical characters of *Aristolochiaceae* have been summarized and



discussed from a taxonomic point of view by HEGNAUER (1960, 1964) and a comprehensive phytochemical review of the family was given by MUNAVALLI & VIEL (1969).

Members of the family tend to deposit  $\text{SiO}_2$  and calcium oxalate in their tissues. Heavy silicification of cell walls (hairs, epidermis, mesophyll) and cell lumina (silica bodies of various shapes) is especially frequent in the tropical members of the three genera in Malesia. Calcium oxalate occurs in the form of prismatic and needle-shaped crystals which are accompanied or replaced in species of *Aristolochia* by druses.

All members of the family possess oil cells producing appreciable amounts of essential oil of taxon-specific composition. These idioblasts occur in roots, rhizomes, leaves and flowers. Depending on taxa and chemodemes monoterpenes, sesquiterpenes or (and) phenylpropanoids are the main constituents of these essential oils.

The nitrophenanthrenes called aristolochic acids and debilic acid and the biogenetically related phenanthrenoid aristolactams occur practically everywhere in *Aristolochia* and have been traced in species of *Thottea* and *Asarum*.

Consideration of the chemistry leads to the conclusion that the affinity of *Aristolochiaceae* is closest with *Annonaceae* as suggested formerly by VON WETTSTEIN. The most convincing evidence comes from the co-occurrence of heavy silicification, essential oil in idioblasts and benzylisoquinoline alkaloids and their degradation products. Both families should be included in *Polycarpiceae* (compare, e.g., *Magnoliiflorae*, DAHLGREN, 1980).

*Literature:* DAHLGREN, Bot. J. Linn. Soc. 80 (1980) 91–124; HEGNAUER, Pharmazie 15 (1960) 634–642; Chemotaxonomie der Pflanzen 3 (1964) 184–199, 639; MUNAVALLI & VIEL, Ann. Pharm. Franç. 27 (1969) 449–464, 519–533, 601–614. — Editor's extract from a large report of R. HEGNAUER.

*Chromosomes.* In *Aristolochiaceae*, chromosome data have been reported for about 90 species of mainly the two (large) genera, viz. *Aristolochia* and *Asarum* (s.l., incl. *Heterotropa* and *Hexastylis*) and only one species of *Apama* (= *Thottea*).

In *Aristolochia* the somatic chromosomes have been reported as  $2n = 8, 10, 12, 14, 24, 26, 28, 32$ . The number in this genus is, with some deviations, rather uniform:  $2n = 14$  (in most of the tropical species) and  $2n = 28$  (in most of the temperate zones) (cf. GREGORY, 1956). There is one widely distributed species, occurring also in Malesia, *A. tagala*, having  $2n = 14$ ; I examined the material of this species from Celebes and New Guinea and obtained the same number. The other numbers occur very unfrequently:  $2n = 12$  (or 24) four times,  $2n = 8, 10, 16, 32$  each once, mostly for extra-tropical species.

In the extra-Malesian genus *Asarum* (s.l.) the chromosomes of many species have been reported mostly with  $2n = 24$  (for Asiatic species) and  $2n = 26$ . There are only a few species with  $2n = 36, 40$ , or 48.

For the genus *Thottea*, there is only one species of *Apama* (= *Thottea*) from India being known with  $2n = 26$  (cf. FEDOROV, 1969).

There is still no chromosome information known for the three monotypic genera, viz. *Euglypha*, *Holostylis* and *Saruma*.

*Literature:* DARLINGTON & WYLIE, Chromosome Atlas ed. 2, 1955, 29; A.A. FEDOROV (ed.), Chromosome numbers of flowering plants, 1969, 58–59; M.P. GREGORY, Amer. J. Bot. 43, 1956, 110–112, tab. 1 & 2, fig. 1–154; R.J. MOORE (ed.), Index to plant chromosome numbers, Regn. Veget. 90, 1973, 162–163; *ibid.* 91, 1974, 31; *ibid.* 96, 1977, 26–27; TANAKA, Bot. Mag. Tokyo 49, 1935, 709–746, f. 1–43.

*Taxonomy.* Though certainly natural, the family is rather heterogeneous: small creeping or erect herbs and large woody lianas, flowers regular or zygomorphic, stamens 6 to many, perianth simple or double, etc. Several genera have outstanding structures: *Asarum* has a leathery capsule bursting irregularly, *Aristolochia* has a bent, zygomorphic complicated flower, the curious South American genus *Euglypha* has also a utricle but not a bent flower and besides has a fruit consisting of 6 one-seeded cocci attached to a sort of columella, the South American genus *Holostylis* is like

*Aristolochia* in flower, but its flower is also straight and does not possess a utricle, *Thottea* has up to 4 whorls of stamens (up to 36–46), and the Chinese genus *Saruma* has a double perianth and 6 halfway free follicles.

Whether the West African genus *Pararistolochia* can be maintained is liable to doubt. KEAY (Fl. W. Trop. Afr. ed. 2, 1, 1, 1954, 77) distinguished it from *Aristolochia* by: 'Fruit indehiscent, elongated, strongly ribbed, cucumber-like', but these characters seem also to occur in the New Guinean *A. dielsii* SCHMIDT (see p. 105). — Editor.

*Affinities.* In the past many suggestions have been made and there is unanimity that most characters point to the assemblage of primitive families in the Dicotyledones, especially through those of the genus *Saruma*. Since WAGNER's research (Oest. Bot. Z. 57, 1907, 265–271) the general opinion prevails that among the living plants the closest affinity is with *Annonaceae* in the general *Magnoliales* concept.

*Uses.* Some American *Aristolochia* species are cultivated for their (rather large) beautiful flowers as ornamentals, e.g. *A. brasiliensis* MART. & ZUCC., *A. elegans* MART. & ZUCC., *A. gigantea* MART. & ZUCC., *A. grandiflora* Sw., *A. ringens* VAHL, etc.

In Malesia some indigenous *Aristolochia* and *Thottea* species are locally cultivated as food plants for the larvae of the beautiful (swallowtail) butterflies, for commercial purposes.

Some members of the *Aristolochiaceae* have been used for drugs, medicine, or medicinal products, especially in the Far East and Southeast Asia. According to published records, such plants or their derivatives have been applied to remedy snake bites, stomach-ache, dysentery, rheumatic affections, colds, headache, toothache, or to reduce swellings and high blood pressure, etc. Aristolochic acid has been reported possessing the capacity to reduce growth of certain types of cancer in mice. For medicinal uses of Malesian plants see the records under the species concerned. For further details one should consult the following literature.

*Literature:* BROWN, Minor Prod. Philip. For. 3 (1921) 183; BURKILL, Dict. (1935) 188–189, 239–240, 2156–2157; CHOW & HWANG, Acta Phytotax. Sinica 13 (1975) 108–109; HEYNE, Nutt. Pl. (1927) 596–597; LIANG, Acta Phytotax. Sinica 13 (1975) 10–28; PERRY, Medic. Pl. E. & SE. Asia (1980) 45–48; PFEIFER, Ann. Mo. Bot. Gard. 53 (1966) 121; QUISUMBING, Medic. Pl. Philip. (1951) 254–256; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 225–226.

*Notes for collectors.* For proper identification flowers are essential. In many cases sterile material is insufficient. Field notes should include information on flower colour and its variation with age of the flowers. As flowers are often delicate in texture, it is advisable to insert some dry material inside the flower before drying, e.g. wool, dry moss, or thin paper, which facilitates later examination in the herbarium. Colour photographs and flowers in liquid are desirable.

If possible, roots should be collected; nothing is known about them in Malesian species.

In several species fruits are not yet known; attention should be given to their development to maturity and release of seeds.

#### KEY TO THE GENERA

1. Flowers actinomorphic. Perianth narrowed at the base and gradually, slightly widened towards the apex, always 3-lobed. Stamens 6–c. 36 (–46), in 1 or 2, rarely 3 or 4, whorls. Capsules usually siliquiform, elongated,  $\pm$  4-angular, 5–10 mm wide, 4-celled. Seeds oblong, ellipsoid, or broadly ovoid, in cross-section usually 3-angular. Stems usually erect, bearing small, bract-like leaves in the lower half, then one small leaf, followed by normal foliage leaves ..... 1. *Thottea*
1. Flowers zygomorphic. Perianth curved, consisting of 3 parts: the inflated basal utricle, the narrowed and neck-like tube, and the elongated, enlarged, or expanded, often 1-lipped, sometimes 3 (–6)-lobed limb. Stamens 6 (10 in *A. decandra*), always in 1 whorl. Capsules not siliquiform, often 6-angular or -ridged, (10–) 15–40 mm wide, 6-celled. Seeds ovate, deltoid, or triangular, often flat. Stems usually scandent, also in erect species, bearing only foliage leaves ..... 2. *Aristolochia*

## 1. THOTTEA

ROTTBOELL, Nye Samling Kongel. Danske Vidensk. Selsk. Skr. 2 (1783) 529; KLOTZSCH, Monatsb. Akad. Berlin (1859) 588; DUCHARTRE in DC. Prod. 15, 1 (1864) 428; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 232; DING HOU, Blumea 27 (1981) 303. — [*Alpam* RHEEDE, Hort. Malab. 6 (1686) 51, t. 28.] — *Apama* LAMK, Encycl. Méth. Bot. 1 (1783) 91; Tabl. Encycl. Méth. (1823) t. 640; SCHMIDT, *fide supra*. — *Bragantia* LOUR. Fl. Coch. (1790) 528; ed. Willd. (1793) 645, *non* VANDELLI (1771). — *Ceramium* BL. Bijdr. (1826-27) 1134, *non* ROTH (1797), *nec* ADANSON (1763). — *Munnickia* BL. ex RCHB. Consp. (1828) 85. — *Vanhallia* SCHULT. in R. & S. Syst. 7 (1829) xviii & 166. — *Trimeriza* LINDL. Bot. Reg. (1832) *sub* t. 1543, in note. — *Asiphonia* GRIFF. Trans. Linn. Soc. 19 (1845) 333. — *Lobbia* PLANCH. in Hook. Lond. J. Bot. 6 (1847) 144. — *Strakaea* PRESL, Epim. Bot. (1851) 221. — **Fig. 1-8.**

Herbs, woody at the base, or undershrubs, rarely shrubs, single or tufted, simple or (sparsely) branched, erect, sometimes rhizomatous or scrambling. *Stems* bearing small, bract-like leaves in the lower 2/3-1/2, then one smaller leaf, followed by normal foliage leaves; (young) branches or branchlets sometimes zigzag. *Leaves* entire; petiole grooved above. *Flowers* actinomorphic, axillary or subradical, solitary or a few on short branches, in spicate or racemose, cymose or corymbose, or cincinnal, usually few-flowered inflorescences. Bract usually opposite to the flower. *Flower buds* (not including the ovary) often distinctly triangular in top view. *Perianth* broad-campanulate, urceolate, bowl- or cup-shaped, 3-lobed; lobes valvate, caducous. *Disk* (?) 0, rarely cupular, adnate to the perianth tube with the apical part free and ring-like (e.g. *T. tomentosa*). *Stamens* 6-c. 36 (-46) in 1 or 2, rarely 3 or 4 whorls, free or adnate to the style column. *Ovary* 4-angular, 4-celled; style (2-) 5-20-lobed, lobes linear or linear-lanceolate. *Capsules* usually siliquiform, elongate, variable in length, 5-10 mm wide,  $\pm$  4-angular, sometimes cruciform in cross-section, dehiscing apically towards the base, or splitting from the central part towards both ends. *Seeds* oblong, ellipsoid, or broadly ovoid, usually 3-angular in cross-section, rarely boat-shaped, often coated with remains of the placenta; testa crustaceous or hard, usually (transversally) rugose, or deeply furrowed, rarely rather smooth or sparse granular.

**Distr.** Indo-Malesia (c. 26 spp.): India (4 spp.), Sri Lanka (1), Bangladesh (1), Burma (3), Thailand (4), Vietnam (2), China (Hainan, 1), and Malesia (22): Sumatra, Malay Peninsula, Java, Borneo, Philippines, and Celebes.

**Ecol.** Often growing sporadically, occasionally locally abundant, in shady places in tropical lowland forest, rarely up to c. 1200 m.

**Notes.** *Thottea* species possess a distinctive leaf architecture: the lower half or two-thirds of the stem carries many (8-12) small, scale- or bract-like, alternate reduced leaves, followed by a single small leaf, which is in turn followed by normal foliage leaves. This was observed by VAN STEENIS in Hortus Bogoriense on specimens of *T. borneensis* and *T. macrantha* and found to be a constant feature in all herbarium specimens with a complete stem.

The occurrence of these three leaf types in this sequence on a single stem has proved useful to recognize



sterile specimens from some erect species of *Aristolochia* (e.g. *A. philippinensis* and *A. sericea*) which have a similar habit, but the stems of which carry only the normal foliage leaf type.

#### SYNOPSIS OF SPOTTING CHARACTERS

*Species are indicated by their numbers*

Stem bearing 1–5 (mostly 2 or 3) leaves at the apical part: 9, 20.

Leaf with 3 prominent nerves, reaching often to the apex, connected with almost parallel and transverse veins: 19.

Leaves with lateral nerves pinnately arranged more or less at regular intervals; venation on the lower surface prominently and closely reticulate: 11, 13.

Leaves villous or densely tomentose beneath and hairs covering almost the whole surface: 7, 8, 20 (young leaves).

Leaf base distinctly cordate, the sinus rather narrow and the auricles or basal lobes often overlapping: 4 (*p.p.*), 5, 6.

Leaves distinctly papillate beneath; papillae forming rings or curves: 14.

Flowers with funnel-shaped perianth, up to c. 12.5 cm long, the largest in this genus: 4.

Flowers with folded perianth more or less round in outline in side view, c. 7 cm  $\varnothing$ , base cordate: 3.

Flowers with stamens arranged in 4 whorls: 1.

Flowers with stamens arranged in 3 whorls: 2.

Flowers with 6 stamens in 1 whorl; style lobes covered with (often hooked) hairs at the upper part: 20.

Flowers with 6 stamens in 1 whorl; anthers with connectives distinctly protruding 0.5–1 mm beyond them: 22.

Style lobes 2 or rarely 3, glabrous: 9.

Seeds boat-shaped, rather smooth and only sparsely granulate on both surfaces: 7.

#### KEY TO THE SPECIES

1. Stamens arranged in 4 whorls (shown distinctly in flower buds) or appearing scattered (in open flowers)
  1. **T. parviflora**
1. Stamens arranged in 1 to 3 whorls.
  2. Stamens arranged in 3 whorls ..... 2. **T. triserialis**
  2. Stamens arranged in 1 or 2 whorls.
    3. Stamens arranged in 2 whorls.
      4. Perianth base prominently cordate, in side view with 2 distinct auricles. Perianth of the (mature) flower, folded in side view, rounded in outline, c. 7 cm  $\varnothing$ ; sinus 1–1.5 cm deep. (Leaves unknown)
        3. **T. straatmanii**
      4. Perianth base obtuse or rounded (in side view).
        5. Leaf base distinctly cordate, the sinus rather narrow and the auricles or basal lobes often overlapping.
          6. Flowers large; perianth up to c. 12 cm long when mature ..... 4. **T. grandiflora**
          6. Flowers smaller; perianth less than 3 cm long when mature.
            7. Perianth c. 23 mm long, deeply 3-lobed; lobes triangular, inner surface densely covered with papillae and glandular hairs. Stamens with papillate filaments. Style lobes 18–20 .... 5. **T. macrophylla**
            7. Perianth 8–10 mm long, shallowly or obscurely lobed; lobes nearly semi-orbicular or triangular, inner surface densely covered with (mainly hooked) hairs. Stamens with glabrous filaments. Style c. 12 lobes ..... 6. **T. robusta**
    5. Leaf base obtuse, rounded, or cuneate.
      8. Leaves with hairs densely covering the whole lower surface, so the latter usually hidden; hairs bent at right angles near the base and parallel to the surface.
        9. Hairs on the lower leaf surface appearing very thin in dry state and sticking together (resembling a layer of gelatine). Perianth lobes with the margin not reflexed at anthesis. Seeds flattened, boat-shaped, rather smooth ..... 7. **T. curvisemen**
        9. Hairs on the lower leaf surface appearing thicker and free from one another. Perianth lobes with the margin reflexed at anthesis. Seeds  $\pm$  ellipsoid, triangular, strongly rugose .... 8. **T. borneensis**
      8. Leaves with hairs rather loosely or sparsely covering the lower surface, so the latter always visible; hairs irregularly spreading, curved or twisted.
        10. Flowers large; perianth up to c. 12 cm long when open ..... 4. **T. grandiflora**
        10. Flowers much smaller; perianth at most 4.5 cm long.

11. Stamens 3 in the upper whorl, 9 in the lower. Style 2- or 3-lobed ..... 9. *T. paucifida*
11. Stamens 6–15 (–18) in the upper whorl, 9–15 (–24) in the lower. Style (4–) 5–19-lobed.
12. Perianth shallowly or obscurely lobed, sometimes  $\pm$  entire.
13. Leaf venation loosely reticulated, veins or veinlets often parallel to one another. Inflorescences at the upper part of stem, in the axils of foliage leaves. Fruits twisted, 15–25 cm long, densely hairy ..... 10. *T. tricornis*
13. Leaf venation closely reticulated. Inflorescences near the base of stem, in the axils of bract-like, reduced leaves. Fruits straight, less than 10 cm long, sparsely hairy or almost glabrous ..... 11. *T. beccarii*
12. Perianth distinctly lobed, often divided to c. half or more of its length.
14. Perianth tube cylindric (c. 1.5 cm long) ..... 12. *T. rhizantha*
14. Perianth tube campanulate, short cupular, obscure, or 0.
15. Leaves with distinctly pinnate, often rather evenly spaced nerves; venation closely reticulate (almost tessellate), prominent beneath ..... 13. *T. philippinensis*
15. Leaves with 1 or 2 pairs of basal nerves and some lateral ones from the midrib, not evenly spaced; venation loosely reticulate, slightly elevated beneath.
16. Leaves with the inner pair of basal nerves emerging from the base. Inflorescences at the upper part of stem, in the axils of foliage leaves.
17. Perianth campanulate, 15–25 mm long; contracted at the lower 1/3 and then erecto-patent, glabrous outside; lobes triangular, flat ..... 14. *T. dependens*
17. Perianth short-cupular, 10–13 mm long, sparsely puberulous outside; lobes reniform, the margin reflexed at anthesis ..... 15. *T. reniloba*
16. Leaves with the inner pair of basal nerves emerging near the base or a few mm from it. Inflorescences at the basal part of stem or near the ground, in the axils of bracts or reduced leaves (almost cauligerous).
18. Perianth c. 15 mm long, lobed to c. 2/3 of the length ..... 16. *T. pennilobata*
18. Perianth 25–45 mm long, lobed up to c. half of the length.
19. Perianth lobes semi-orbicular, 10 by 15 mm, at apex subrounded or slightly apiculate ..... 17. *T. celebica*
19. Perianth lobes triangular, 20–25 by c. 20 mm, at apex acuminate ... 18. *T. muluensis*
3. Stamens arranged in 1 whorl.
20. Leaves with the inner pair of basal nerves extending to the apex, joined by predominantly rather close, transverse, parallel veins. Inflorescences corymbose or paniculate ..... 19. *T. corymbosa*
20. Leaves with the inner basal pair of nerves extending usually to c. half, rarely more, of the length, joined by rather loose, transverse and reticulate veins. Inflorescences usually spicate or racemose.
21. Plant bearing 1–5 (often 2 or 3) foliage leaves. Leaves densely tomentose or villous beneath especially when young. Inflorescences near the base of stem. Style lobes densely covered with (hooked) hairs at the apical part ..... 20. *T. tomentosa*
21. Plant bearing many foliage leaves. Leaves pubescent or puberulous beneath. Inflorescences at the upper part of stem. Style lobes glabrous.
22. Perianth lobes broadly rounded, c. 12 by 4 mm, emarginate. Stamens 9–12; connective not protruding beyond the anthers ..... 21. *T. macrantha*
22. Perianth lobes ovate to lanceolate, 8–15 by 5–8 mm, apex acute, acuminate, or obtuse. Stamens 6; connective protruding c. 0.5 mm beyond the anthers ..... 22. *T. sumatrana*

1. *Thottea parviflora* RIDLEY, J. Str. Br. R. As. Soc. n. 57 (1911; nec 1910) 89; Fl. Mal. Pen. 3 (1924) 17; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 232; BURK. Dict. 2 (1935) 2157; DING HOU, Blumea 27 (1981) 305, f. 38–40, 70D. — Fig. 7n–p.

Erect shrub, up to 2 m high. Branches subterete or obscurely angular, c. 7 mm  $\phi$ , pubescent. Leaves chartaceous, ovate, obovate, broad-elliptic, elliptic, or lanceolate, 10–26 by 4.5–9 cm; apex acuminate; base rounded, cuneate, or attenuate; sparsely puberulous or almost glabrous above, puberulous beneath; basal nerves 2 or 3 pairs, emerging 2–5 mm from the

midrib above the base, similar to the lateral nerves, ascending upward to 2/3 or more of the blade, the outer 1 or 2 pairs much weaker and shorter; lateral nerves 6–9 pairs, elevated beneath, flat but distinct, or slightly elevated above; veins  $\pm$  parallel and scalariform, sometimes  $\pm$  transverse at the basal part between the inner pair of basal nerves, connected with parallel or reticulate veinlets, elevated beneath, faint above; petiole 3–7 mm, puberulous. Inflorescences axillary, often in the axils of leaf scars, usually simple and spiciform, up to 1.5 cm long; bracts lanceolate, 1–4 mm long, puberulous on both surfaces. Pedicel



Fig. 3. *Thottea grandiflora* ROTTB.,  $\times 1/3$ . Possesses the largest flowers in the genus. Singapore (Photogr. CORNER).



and ovary very short, c. 6 mm long, densely puberulous. *Perianth* white, whitish green with a pink basal patch inside, pale pink or pink, pale purplish or violet, discoid, 2–4 mm long, c. 6 mm  $\phi$ ; with longitudinal and loosely reticulate veins, loosely puberulous outside and papillate inside, glabrescent; lobes semi-orbicular, 1.5–3 by 3.5–4.5 mm. *Stamens* (15–) 20–22, in 4 whorls (can easily be observed in young buds); filaments 0.4–1 mm, short-hairy; anthers oblong, c. 0.7 mm long. *Style* almost branched from the base, c. 1.7 mm, lobes usually 4 or 5, glabrous. *Capsules* slender, up to 9 cm long, acute or pointed at both ends, obscurely 4-angular, slightly twisted, loosely puberulous. *Seeds* ellipsoid, 3–3.5 by 1.5 mm, triangular, irregularly and transversely corrugated.

*Distr.* Peninsular Thailand; in *Malesia*: Malay Peninsula (Kedah, also Langkawi, Perak, Kelantan, Pahang, Selangor).

*Ecol.* In lowland forest, occasionally in swampy forest, up to 150 m; in Thailand occasionally found also on granitic rock in the forest, up to 700–1055 m. *Fl.* March–July, *fr.* March–August.

*Uses.* Rootstock is eaten with rice for remedy of coughs.

*Vern.* *Chudok*, Pahang.

**2. *Thottea triserialis* DING HOU, Blumea 27 (1981) 330, f. 35, 41, 42.**

Shrublet of 120 cm high. Branches terete, c. 5 mm  $\phi$ , pubescent. *Leaves* chartaceous, elliptic, broad-elliptic, slightly obovate, or ovate, 23–34 by 11–23 cm; apex acuminate or acute; base rounded or obtuse in outline but cordate (sinus narrow, 0.5–0.75 cm deep, auricles overlapping or touching each other); glabrous above, sparsely pubescent beneath; basal nerves 2–3 pairs, starting almost from the insertion of the petiole, the inner one ascending upward to 1/2–2/3 of the blade, similar to the lateral ones, the outer 1 or 2 short and weak; lateral nerves 7 or 8 pairs, prominently elevated below, often flat but distinct above; veins scalariform, connected with loosely reticulate or straight veinlets, elevated beneath, obscure above; petiole very short or obscure, sometimes up to c. 5 mm, pubescent. *Inflorescences* in the axils of foliage leaves or their scars, spiciform, solitary or fasciculate, 3–5 cm long, pubescent; bracts lanceolate, elliptic, or oblanceolate, 3–15 mm long, pubescent. Pedicel and ovary 18–20 mm long, densely pubescent. *Perianth* pink or pinkish brown, cupular, 10–15 mm long, slightly contracted at the lower 1/3–1/2, almost orbicular in outline when open (10–15 mm  $\phi$ ), veins loosely reticulate, sparsely puberulous on both surfaces; tube short, terete, c. 5 mm long; lobes semi-orbicular, 5–10 by 11–15 mm, apex acute or cuspidate. *Stamens* in 3 whorls: upper row 5–8, middle 7–12, lower 12–16; filaments hairy,

0.5–1 mm; anthers oblong, c. 1.25 mm long. *Style* column c. 2 mm long, lobes 11–20, 1.5–2 mm, glabrous. *Capsule* (very young) siliquiform, 12 cm long, pubescent. *Seeds* flat (?).

*Distr.* *Malesia*: Borneo (Sarawak: Lundu Distr.; G. Puch). Twice collected.

*Ecol.* In primary lowland dipterocarp forest, on gentle ridge slope, 600–1080 m. *Fl. fr.* April.

*Note.* Vegetatively not distinguishable from *T. macrophylla* and *T. robusta*. The inner surface of the perianth is glabrous; it is densely hairy in the other two species (glandular hairs in the former, mainly hooked-hairy ones in the latter). The stamens are arranged in 3 whorls, a unique character in the genus.

**3. *Thottea straatmanii* DING HOU, Blumea 28 (1983) 352, f. 6.**

Plant c. 2.5 m high. *Leaves* not preserved, (from a sketch) ovate-oblong, c. 30 cm long. *Inflorescence* cauligerous, spiciform, 2 cm long, puberulous, internodes 7–10 mm long; bracts leafy, ovate, 4.5–13 by 2.5–8 mm, puberulous on both surfaces. Pedicel and ovary c. 17 mm long, puberulous. *Perianth* when folded in side view  $\pm$  orbicular in outline, c. 7 cm  $\phi$ , cordate at base, sinus c. 12 mm deep, distinctly bi-auriculate; perianth deeply lobed, lobes  $\pm$  orbicular, c. 7 cm  $\phi$ , puberulous outside, loosely glandular hairy inside, veins rather loosely reticulate. *Stamens* in 2 whorls: upper row c. 18, lower c. 24; filaments glabrous, very short or 0; anthers oblong, 1.5–2 mm long. *Style* column c. 3 mm long, lobes c. 12, c. 1.5 mm. *Capsule* siliquiform, slightly curved, 15–21 cm long, slightly 4-angular, narrowed at both ends, puberulous. *Seeds* broad-ellipsoid, triangular, 3.5 by 2 mm, transverse-rugose, deeply grooved.

*Distr.* *Malesia*: NE. Sumatra (East Coast: Laut Tador).

*Ecol.* Growing very locally in wet shady places in open forest, at c. 100 m.

*Notes.* In flower size the second largest in the genus (perianth c. 7 cm in diam.), next to *T. grandiflora* (12.5 cm).

Closely related to *T. reniloba* with which it shares the spaced bracts and distinct internodes, the deeply lobed perianth, 2-whorled stamens, pubescent capsules and deeply grooved seeds, but different by larger,  $\pm$  orbicular perianth lobes, the higher number of stamens (upper whorl c. 18, lower c. 24) and the transverse-rugose seeds.

The forest of the type locality is now destroyed.

**4. *Thottea grandiflora* ROTTBOELL, Nye Samling Kongel. Danske Vidensk. Selsk. Skr. 2 (1783) 529, t. 2; BENN. & BROWN, Pl. Jav. Rar. 1 (1838) 45; GRIFF. Trans. Linn. Soc. 19 (1845) 325, t. 36; Ann. Sc. Nat. Bot. 7 (1847) 328; Notul. 4 (1854) 346; Ic. Pl. Asiat. (1854) t. 530 & 531; Miq. Fl. Ind. Bat. 1, 1 (1858)**



Fig. 4. *Thottea robusta* STEEN. a. Habit, nat. size, b. young inflorescence, c. open flower, both  $\times 2$ , d. gyno-stemium,  $\times 7$ , e. dehiscent fruit, nat. size (VAN STEENIS 1270).

1068; KLOTZSCH, Monatsb. Akad. Berl. (1859) 5 & 9, t. 1 f. 3; DUCHARTRE in DC. Prod. 15, 1 (1864) 428; HOOK. f. Fl. Br. India 5 (1886) 74; SOLEREDER, Bot. Jahrb. 10 (1889) 429 & 478; in E. & P. Nat. Pfl. Fam. 3, 1 (1889) 272; RIDL. J. Str. Br. R. As. Soc. Beng. 75, ii (1912) 27; RIDL. Fl. Mal. Pen. 3 (1924) 16; HEYNE, Nutt. Pl. (1927) 596; BURK. Dict. 2 (1935) 2156; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 232; HEND. Mal. Wild Fl. (1951) 424, f. 383; DING HOU, Blumea 27 (1981) 308, f. 8–10, 317, f. 62. — Fig. 3.

Erect shrub, up to 2 m high. Branches terete, c. 1 cm  $\varnothing$ , villous. *Leaves* coriaceous, obovate, elliptic, ovate-oblong, or lanceolate, (15–) 20–30 (–45) by 9–10 (–25) cm; apex acute, short-acuminate, sometimes cuspidate; base obtuse, sometimes subcordate, rarely cuneate; villous, glabrescent or almost glabrous above, hispid-pubescent beneath; basal nerves 2 or 3 pairs, the inner one obliquely extending upward to c. half the blade, the outer one weaker and shorter, running along the margin; lateral nerves 10–12 pairs; all nerves prominent below, slightly elevated above; veins  $\pm$  parallel or reticulate, elevated below, distinct above; petiole 0.5–1.5 cm, villous. *Inflorescences* usually at the lower part of the stem in the axils of (fallen) leaves, simple or sparsely branched, sometimes branched near the base and seemingly fascicled, spiciform or racemiform, 1–7 cm long, villous; bracts lanceolate or elliptic, 1–3 cm long, villous on both surfaces. Pedicel and ovary up to 4 cm long, villous. *Perianth* deep claret-coloured and purple mottled, funnel-shaped, up to c. 12.5 cm long and as broad at the mouth (largest flower in this genus), with distinct and reticulate veins; pubescent without especially on the venation, puberulous inside, usually glabrescent; tube about half the length of the perianth; lobes triangular or suborbicular, 5–6 by 6–7 cm, acute or rounded at the apex. *Stamens* in 2 whorls: upper row c. 15 (–18), lower c. 15 (–24); filaments glabrous, very short; anthers oblong, c. 1.5–2 mm long. *Style* column short; lobes 8–19, c. 2.5 mm. *Capsules* slender, 10–15 cm long, straight or twisted, 4-angular, pubescent. *Seeds* ellipsoid, 3–4 mm long, trigonous, acute at both ends, rugose-tubercled.

Distr. Peninsular Burma (Moulmein); in *Malaysia*: Malay Peninsula (Perak, Trengganu, Pahang, Negri Sembilan, Malacca, Johore, Singapore).

Ecol. In lowland forest, up to 600 m. *Fl. fr.* almost all year round.

Vern. *Grobo*, Malacca; *sel-wohl*, Pahang.

**5. *Thottea macrophylla*** BECC. Nuov. Giorn. Bot. Ital. 2 (1870) 5, t. 1: f. 1–6; STEEN. Bull. Jard. Bot. Btzig III, 12 (1932) 205; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 232; DING HOU, Blumea 27

(1981) 312, f. 34, 330.

Erect shrub. Branches terete, c. 5 mm  $\varnothing$ , pubescent. *Leaves* coriaceous, elliptic-obovate, or obovate, 23–35 by 14–20 cm; apex acuminate; base obtuse or rounded in outline, shallow-cordate, sinus narrow, with auricles slightly overlapping each other; glabrous above, pubescent beneath; basal nerves 3 pairs, the inner pair similar to lateral ones, extending upward to c. 2/3 of the blade, outer 2 much weaker and shorter, close to the margin; lateral nerves c. 7 pairs, prominent below, distinct or slightly elevated above; veins crossbar-like, parallel, scalariform, veinlets transverse or reticulate, elevated and prominent beneath, distinct or obscure above; petiole 0.5–1 cm long, pubescent. *Inflorescences* in the axils of foliage leaves, solitary or sometimes 2, spiciform, c. 1.5 cm long, densely pubescent; bracts elliptic, obovate or oblanceolate, 3.5–9 by 1.5–3 mm, densely puberulous on both surfaces. Pedicel and ovary 17–20 mm long, densely puberulous. *Perianth* campanulate, c. 23 mm long, up to c. 45 mm  $\varnothing$ , deeply 3-lobed, outer surface with distinctly pubescent reticulations, less hairy between the veins, inner surface densely covered with papillae and glandular hairs (appearing carpet-like); tube very short; lobes triangular, c. 18 by 24 mm, short-acuminate. *Stamens* in 2 whorls: upper row 10 or 11, lower 16 or 17; filaments papillate, 0.5–1 mm; anthers oblong, c. 1.5 mm long. *Style* column c. 3 mm long; lobes 18–20, c. 3 mm long, glabrous. Capsules unknown.

Distr. *Malaysia*: Borneo (Sarawak: Mt Matang). Twice collected.

Ecol. In forest, c. 750 m. *Fl.* April & July.

**6. *Thottea robusta*** STEEN. Bull. Jard. Bot. Btzig III, 12 (1932) 205, f. 11; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 232; DING HOU, Blumea 27 (1981) 330, f. 36, 37, 57–60. — Fig. 4.

Erect shrub, 3–4 m high. Branches terete, c. 1 cm  $\varnothing$ , villous on young parts, glabrescent. *Leaves* chartaceous, variable in shape and size, obovate, subrhomboidal, ovate-oblong to oblong-lanceolate, 17.5–40 by 7.5–25 cm; apex acute or acuminate; base broadly rounded in outline and distinctly cordate, the auricles overlapping each other; glabrous above, pubescent or villous beneath, especially on the midrib and venation; basal nerves 2 or 3 pairs, emerging flabellately from the base, the inner one ascending upward to  $\pm$  halfway, similar to the lateral nerves in thickness and appearance, the outer 1 or 2 much weaker and shorter and close to the margin; lateral nerves 6–8 pairs, prominent beneath, distinct or slightly elevated above; veins transverse, parallel and scalariform, connected with crossbar-like or reticulate veinlets, elevated below, distinct or obscure above; petiole stout, 0.5–1.5 cm, densely pubescent. *Inflorescence* in the axils of foliage leaves, solitary or



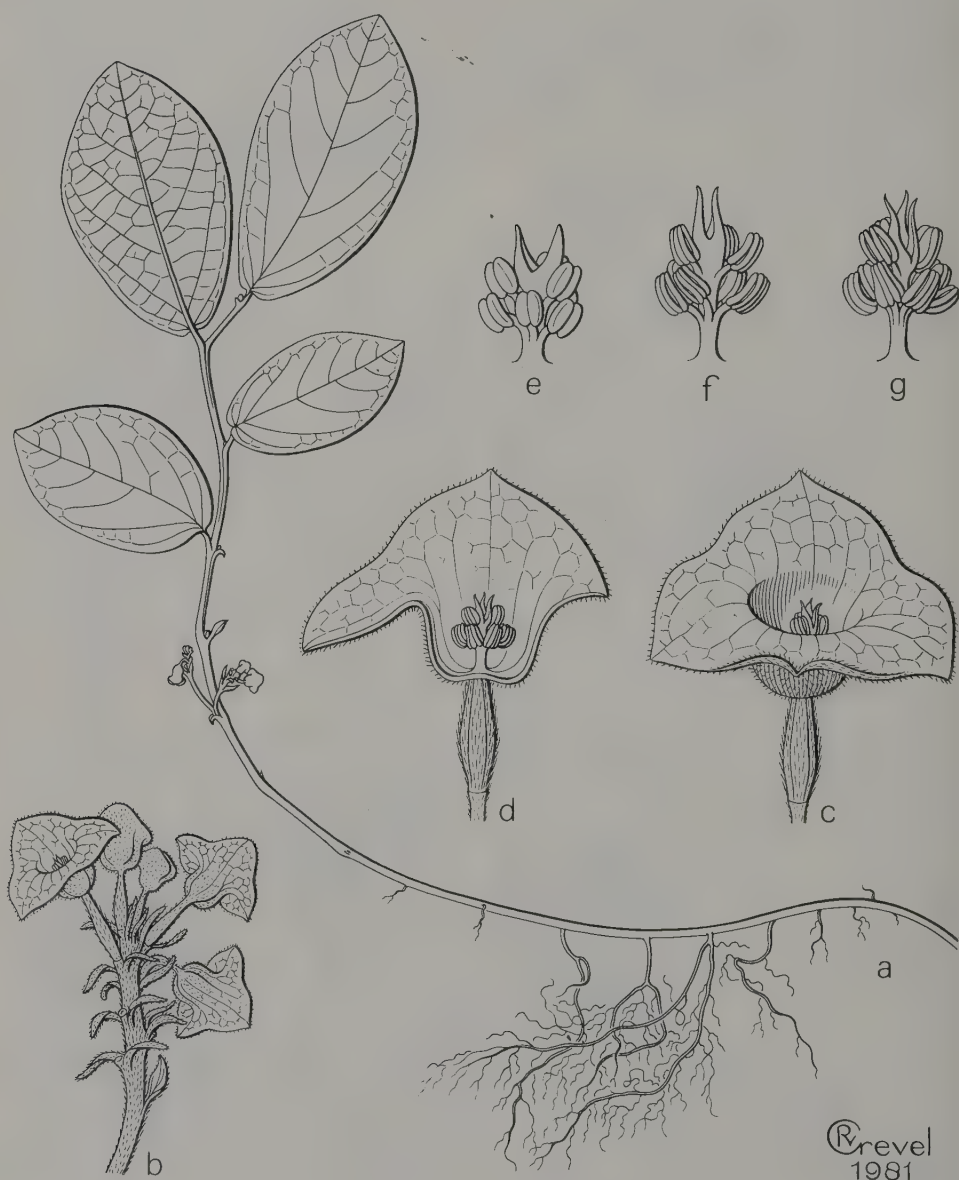


Fig. 5. *Thottea paucifida* DING HOU. a. Habit,  $\times \frac{1}{2}$ , b. inflorescence,  $\times 2$ , c-d. flowers,  $\times 4\frac{1}{2}$ , e-g. gynostemium, with 2- or 3-fid style,  $\times 9$  (BROOKE 10009). Courtesy of Blumea.

in fascicles of 2 or 3, sometimes sparsely shortly branched, spiciform, 0.5–3.5 cm long, densely villous; bracts ovate to spatulate, crowded, 5–9 mm long, densely pubescent or villous. Pedicel and ovary short, c. 5 mm, densely pubescent or villous. *Perianth* pale wine-red, shallowly broad-campanulate, 8–10 mm long, c. 17 mm  $\phi$ ; outer surface with strongly prominent, villous reticulations, less hairy between the veins; inner surface densely covered with short (mainly hooked) hairs; tube 3–5 mm long, shallowly or obscurely lobed, lobes nearly semi-orbicular or triangular, c. 5 by 10 mm. *Stamens* in 2 whorls: upper row 7 or 8, lower c. 14; filaments glabrous, 0–0.7 mm; anthers oblong, 0.7–1 mm long. *Style* column short, c. 1.5 mm long, lobes c. 12, glabrous. *Capsules* narrow spindle-shaped, straight or falcate, not or only slightly twisted at the top, 8–11.5 cm long, villous. *Seeds* ovoid, c. 4 by 2 mm, trigonous, tuberculate.

Distr. *Malesia*: Malina Islands (NW off Borneo) (Bunguran: E. slope of G. Ranai); once collected.

Ecol. Primary forest, along stream, c. 250 m. *Fl.* fr. April.

Vern. *Kaju ribal*, M.

**7. *Thottea curvisemen*** DING HOU, *Blumea* 27 (1981) 320, f. 32, 33, 64–66.

Erect shrub, 1–1.30 m high. Branches subterete, 4–6 mm  $\phi$ , pubescent. *Leaves* chartaceous, broad-elliptic or elliptic, 18.5–26 by 9–18 cm; apex acuminate; base rotund; glabrous above, sericeous beneath; basal nerves 2 (rarely 3) pairs, the inner one ascending obliquely upward to halfway, the outer 1 or 2 weak and short, close to the margin; lateral nerves 6–9 pairs; veins distinctly crossbar-like; nerves and veins prominent beneath, visible rarely distinct above; petiole c. 1 cm, pubescent. *Inflorescences* axillary, in axils of bracts or reduced leaves, spiciform, c. 3 cm long, puberulous; bracts elliptic or slightly obovate, 2.5–3 mm long, both surfaces puberulous. Pedicel and ovary 7–12 mm long, puberulous. *Perianth* bright purple, short-cupular, c. 12.5 mm long, with distinct, longitudinal veins, sparsely puberulous outside, densely glandular hairy inside; tube short-cupular, c. 9.5 mm long; lobes arcuate, c. 3 by 10 mm, obscurely cuspidate at the apex. *Stamens* in 2 whorls: upper one 8–10, lower 11–14; filaments glabrous, 1–1.5 mm; anthers oblong, 1–1.5 mm long. *Style* column c. 2 mm long; lobes 6–12, radiate, c. 1.5 mm long. *Capsule* (only one seen) narrow fusiform, 4.5 by 0.6 cm, straight, distinctly 4-angular, almost glabrous. *Seeds* flattened, boat-shaped, broad-ellipsoid in side view, c. 2–2.5 mm long,  $\pm$  obtuse or truncate at both ends (depending on the position in the fruit), rather smooth with only sparse granules on both surfaces.

Distr. *Malesia*: Borneo: Sarawak (Kapit: Bukit

Raya, Pelagus), once collected.

Ecol. In lowland dipterocarp forest, 240 m, on slopes of steep ridges. *Fl.* fr. August.

Note. Allied to *T. borneensis*.

**8. *Thottea borneensis*** VALET. *l.c.* Bog. (1908) t. 261; SCHMIDT in E. & P. *Nat. Pfl. Fam.* ed. 2, 16b (1935) 232, f. 120P; DING HOU, *Blumea* 27 (1981) 321, f. 29–31.

Erect shrub up to 2 m high. Branches terete, up to 2 cm  $\phi$ , glabrous. *Leaves* chartaceous, elliptic, ovate-oblong, or obovate, 17–27 (–30) by 6.5–14 (–19) cm; apex acute, acuminate, sometimes cuspidate; base obtuse or cuneate; glabrous above, densely sericeous beneath; basal nerves 2 pairs, the inner one as prominent as the lateral ones, extending upward to 2/3 or more of the blade, the outer one very weak and short; lateral nerves 5–8 pairs, prominent beneath, distinct above; veins and veinlets transverse or slightly curved,  $\pm$  scalariform, or loosely reticulate, slightly elevated below, visible or obscure above; petiole 1–1.5 cm, slightly pubescent. *Inflorescences* axillary, simple or sparsely branched near base, 4–7 cm long, with one or a few flowers at the apical part, pubescent; bracts many, ovate or lanceolate, 1–3 mm long, densely puberulous outside, sparsely puberulous or glabrous inside. Pedicel and ovary 7–12 mm long, densely puberulous. *Perianth* cupular, 8–12 mm long, c. 15 mm  $\phi$ , dark purple; densely pubescent outside, sparsely puberulous inside; tube 4–6 mm long; lobes semi-orbicular or broadly ovate, 4.5–6 by 4.5–9 mm, erect, at anthesis the marginal part reflexed and the base biauriculate. *Stamens* in 2 whorls: upper row 10–13, lower 14–17; filaments glabrous, c. 0.5 mm; anthers oblong, c. 1 mm long. *Style* column obscure; lobes 9, radiately ascending, c. 1 mm long. *Capsules* siliquiform, pendulous, twisted, 9 cm long. *Seeds*  $\pm$  ellipsoid, c. 5 by 2 mm, strongly rugulose.

Distr. *Malesia*: Sumatra (West Coast: Padang) and Borneo (Landak; Kapuas: Mt Biang). Cultivated in the Hort. Bogor., from plants collected by TEYSMANN in Borneo, under the numbers XI-B-XIII. 76 & 134.

Ecol. *Fl.* Sept.–Nov. No other field ecological data recorded.

Note. See the note under *T. reniloba*.

**9. *Thottea paucifida*** DING HOU, *Blumea* 27 (1981) 324, f. 23, 24, 71. — **Fig. 5.**

Undershrub, creeping below and rooting, then ascending, up to 30 cm high. Branches subterete, c. 3 mm  $\phi$ , puberulous, glabrescent. *Leaves* chartaceous, 4.5–8 by 2.5–4.5 cm; apex acute or obtuse; base rotund or obscurely cordate; sparsely pubescent on both surfaces; basal nerves 1 or 2 pairs, usually thinner than the lateral ones, ascending upward to about

halfway; lateral nerves 4–6 pairs, slightly elevated below, distinct or faint above; veins crossbar-like and loosely reticulate, distinct or faint below, obscure above; veinlets obscure; petiole 2–3 mm, pubescent. *Inflorescences* axillary, in the axils of fallen leaves near the basal part of the stem, spiciform, simple or once branched, 1–3 cm long, puberulous; bracts linear, 2–5 mm long, densely puberulous on both surfaces. Pedicel and ovary 4.5–5 mm long, densely puberulous. *Perianth* cream colour, cupular, 6 mm long, with loose reticulations; tube 3 mm long, densely papillate inside; lobes subrotund or triangular, 3 by 3.5 mm, sparsely puberulous inside, apiculate at the apex. *Stamens* in 2 whorls: upper row 3, lower 6; filaments glabrous, 0–1 mm; anthers oblong, c. 0.5 mm long. *Style* column 1.25 mm long; lobes 2 or 3, c. 0.5 mm. Capsules unknown.

*Distr. Malesia:* Borneo (Sarawak: Div. 5, La-was); once collected.

*Ecol.* On the banks of a stream through stands of rubber and other trees. *Fl.* May.

*Note.* Allied to *T. tomentosa*, but leaves lax-pubescent underneath, perianth without annular ridge in the apical part of the tube, 9 stamens in 2 whorls, and 2 (or 3) glabrous style lobes.

**10. *Thottea tricornis*** MAINGAY *ex* HOOK. *f.* *Fl. Br. India* 5 (1886) 74; SOLENER, *Bot. Jahrb.* 10 (1889) 430 & 506; KING & GAMBLE, *J. As. Soc. Beng.* 75, ii (1912) 29; RIDL, *Fl. Mal. Pen.* 3 (1924) 16; SCHMIDT in E. & P. *Nat. Pfl. Fam.* ed. 2, 16b (1935) 232; DING HOU, *Blumea* 27 (1981) 318, f. 2, 17, 18, 43, 44, 61, 70B. — **Fig. 7f–i.**

Erect shrub, up to 2 m high. Branches terete or slightly angular, c. 1 cm  $\phi$ , pubescent. *Leaves* chartaceous or subcoriaceous, elliptic, lanceolate, obovate-oblong, or oblanceolate, 20–30 by 8.5–16 cm; glabrous above, pubescent beneath; apex acute or acuminate; base cuneate or rounded; basal nerves 2 pairs, emerging from the base, the inner one ascending upward reaching to c. 2/3 or higher, similar to the lateral ones, the outer one weak and short; lateral nerves 6–8 pairs, prominently elevated beneath, slightly elevated above; veins transverse, scalariform, connected by crossbar-like or reticulate veinlets, elevated beneath, often faint above; petiole 5–17 mm, pubescent. *Inflorescences* in the axils of foliage leaves, racemi- or paniculiform, up to 5 cm long, pubescent; bracts ovate, lanceolate, or linear, 3–6 mm long, puberulous. Pedicel and ovary 1.25–2 cm, densely pubescent or velvety. *Perianth* magenta or violet, campanulate, slightly contracted at the lower part, 1.5–2 cm long, suborbicular or six-angular in outline, 2.5–3.5 cm  $\phi$ , densely pubescent outside, inner surface densely covered with glandular hairs and appearing mat-like; obscurely lobed, lobes triangular, 5–10 by 16–30 mm, apex acute or mu-

cronate. *Stamens* in 2 whorls, upper row 6–10, lower 10–14; filaments glabrous, c. 1 mm; anthers oblong, c. 1 mm long. *Style* column c. 2 mm long; lobes 5–13, c. 1.5 mm, glabrous. *Capsules* slender, rather long, 15–25 cm long, slightly curved or twisted, 4-angular, densely pubescent or velvety. *Seeds* oblong, 4–5 by 2 mm, trigonous, coarsely granulate.

*Distr.* Peninsular Thailand (Chawang), and *Malesia:* Malay Peninsula (Perak, Pahang, Selangor, Malacca).

*Ecol.* Undergrowth in forest, 300–600 m. *Fl.* Feb.–May, *fr.* Feb.–Aug.

*Vern.* *Melada*, Selangor; *telinga kelawar*, Pahang.

**11. *Thottea beccarii*** DING HOU, *Blumea* 27 (1981) 315, f. 25, 26, 51, 52.

Erect shrublet, 75–120 cm high. Branches  $\pm$  terete, 0.5–0.7 cm  $\phi$ , lower part rather straight, upper part slightly zigzag, slightly pubescent, glabrescent. *Leaves* firmly chartaceous, elliptic, rarely lanceolate or oblanceolate, 20–35 by 7.5–15 cm; apex short-acuminate; base cuneate; sparsely pubescent above when young, glabrescent, often almost glabrous when old, pubescent beneath; nerves 6–9 pairs, usually pinnate, usually the basal pair for 0.5–0.7 cm united with the midrib, ascending up to 1/2–2/3 of the blade, sometimes one weak, short pair starting from the very base and extending along the margin; veins and veinlets closely reticulate, or  $\pm$  crossbar-like; both nerves and veins prominent below, obscure above; petiole very short, 5–7 mm, slightly pubescent. *Inflorescences* near the basal part of stem, 1 or 2 in an axil of a scale-like leaf, c. 5 cm long, spiciform, slightly puberulous; bracts lanceolate, linear, or oblanceolate, 5–6 mm long, rarely 2-lobed, sparsely puberulous on both surfaces. Pedicel and ovary 15–17.5 mm long, sparsely puberulous. *Perianth* cupular, 12–17.5 mm long, 20–25 mm  $\phi$ , obscurely lobed; tube c. 10 mm long; lobes arcuate, 3–5 by 15–20 mm, slightly acute at the apex. *Stamens* in 2 whorls: upper row 7–10, lower 13 or 14; filaments hairy (?) or glabrous, 0.3–0.6 mm; anthers oblong, c. 1 mm long. *Style* column c. 2 mm long; lobes c. 10, erect, c. 1 mm long. *Capsules* siliquiform, 6.5–9 cm long, 4-angular, straight, narrowed and pointed at both ends, sparsely hairy or almost glabrous. *Seeds* broad-ellipsoid or subglobose, obscurely triangular on cross-section, 2 by 1.5–1.3 mm, prominently rugose, with transverse bars and tubercles, deeply furrowed.

*Distr.* *Malesia:* Sumatra (Padang and Asahan), 4 collections.

*Ecol.* At c. 360 m. *Fl.* *fr.* August.

*Vern.* *Kaju pinggu batu*, Asahan.

*Notes.* Allied to *T. borneensis* but differing by the closely reticulate venation and scattered hairs; in *T. borneensis* the venation is scalariform or loosely



reticulate and hairs are densely matted beneath.

Also allied to *T. tricornis* by the closely reticulate venation and inflorescences near the base of the stem, in the axils of bract-like reduced leaves, and further by the fruit and seed.

**12. *Thottea rhizantha*** BECC. Nuov. Giorn. Bot. Ital. 2 (1870) 6, t. 1: 7–10; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 232, f. 120K; DING HOU, Blumea 27 (1981) 311, f. 45–47.

Erect shrub or treelet, up to c. 1.25 m high. Branches terete, c. 1 cm ø, densely tomentose or villous, sometimes glabrescent. *Leaves* subcoriaceous, elliptic, oblanceolate, or oblong, 21–42.5 by 9.5–16.5 cm, apex acuminate; base cuneate or obtuse; glabrous above, tomentose beneath especially on the midrib, nerves and veins; basal nerves 2 pairs, emerging from the base, the inner one extending upward to about halfway, similar in thickness and appearance to the lateral ones, occasionally with some secondary nerves, outer one very weak, short and close to the margin; lateral nerves 8–10 pairs, elevated and prominent beneath, distinct or flat above; veins usually transverse and scalariform, connected with crossbar-like or loosely reticulate veinlets, elevated beneath, often faint or invisible above; the petiole c. 5 mm, densely pubescent. *Inflorescences* near the base of the stem, in the axils of bracts, few-branched, paniculiform or racemiform, internodes spacious, villous; bracts ovate, c. 10 mm long, villous. Pedicel and ovary 10–15 mm, pubescent. *Perianth* outside faintly violet tinged, inside violet at the base, white at the top, or red with white, funnel-shaped, 3–3.5 cm long, c. 3.5 cm ø, with distinct longitudinal and loosely reticulate veins, pubescent outside, glandularly hairy inside; tube cylindric, c. 1.5 cm long; lobes suborbicular, 1.5–2 by 1.2–2 cm, apical part rounded, acute, or rarely apiculate. *Stamens* in 2 whorls: upper row 6–8, lower 13–15; filaments glabrous, 0–0.5 mm; anthers oblong, c. 1.5 mm long. *Style* column 2.5 mm long, lobes 5–7, c. 1.5 mm, glabrous. Capsules unknown.

*Distr. Malesia:* Sumatra (Djambi: Sg. Lesing near Pauh); Borneo (Sarawak: Bellaga near Bintulu; Kapit Distr.).

*Ecol.* In primary hill forest on sandstone substratum, mixed dipterocarp forest on ridge, or on ridge in old secondary forest, up to 500 m.

*Uses.* Roots boiled in water is taken to cure gonorrhoea in Sarawak.

*Vern.* Sumatra: *mai-mai*, Sg. Lesing; Sarawak: *keh*, Punan lang.

**13. *Thottea philippinensis*** QUIS. Philip. J. Sc. 41 (1930) 322, t. 2; DING HOU, Blumea 27 (1981) 306, f. 1; *ibid.* 29 (1983) 242. — **Fig. 8a.**

Erect undershrub up to c. 70 cm high. Branches

subterete, c. 0.5 cm ø, pubescent. *Leaves* thin-coriaceous, lanceolate to narrow-lanceolate, oblong-elliptic or elliptic-lanceolate, 16–26 (–39) by 4–9 (–13) cm; apex acuminate; base rounded or cuneate; glabrous above, pubescent beneath; nerves pinnate, basal pair weak and short, close to the margin, up to 1/4–1/3 of the blade; lateral nerves 8–13 pairs, elevated and prominent beneath, slender above; veins and veinlets closely reticulate, prominent beneath, rather faint above; petiole c. 5 mm, pubescent. *Inflorescences* at the basal part of the stem, in the axils of reduced leaves, spiciform, up to 5 cm long, pubescent. Bracts elliptic, 2–5 mm long, puberulous on both surfaces. Pedicel and ovary 8–13 mm, densely puberulous. *Perianth* light bluish purple, blue and pink, or dark red outside and whitish inside, campanulate, 16–22 mm long, 10–20 mm ø, with loosely reticulate veins, puberulous outside, glandular hairy inside; tube 10–15 mm long; lobes triangular or semi-orbicular, 6–7 by 11–16 mm, apex acute or apiculate (the apical part usually incurved and the apex seemingly obtuse). *Stamens* in 2 whorls: upper row 8–10, lower 12–14; filaments glabrous, 1–1.5 mm; anthers oblong, 1.3 mm long. *Style* column 5–7 mm; lobes 4–6, glabrous. *Capsule* fusiform (only open, empty valves seen), c. 3 cm long, pubescent. Seeds not seen.

*Distr. Malesia:* Philippines (Mindanao: Lanao Prov.) and Borneo: Sarawak (4th Div., Lambir Nat. Park). Twice collected.

*Ecol.* In dipterocarp forest and on sheltered sandstone cliff, 150–450 m. *Fl. fr.* March, Sept.

*Vern.* *Taguibunon*, Lanao.

*Note.* See the note under *T. celebica*.

**14. *Thottea dependens*** (PLANCH.) KLOTZSCH, Monatsbl. Akad. Berl. (1859) 589; DUCHARTRE in DC. Prod. 15, 1 (1864) 428; HOOK. f. Fl. Br. India 5 (1886) 74; SOLEREDER, Bot. Jahrb. 10 (1889) 429; in E. & P. Nat. Pfl. Fam. 3, 1 (1889) 272; RIDLEY, J. Str. Br. As. Soc. n. 33 (1900) 127; KING & GAMBLE, J. As. Soc. Beng. 75, ii (1912) 28; GRESHOFF, Meded. Lands Pl. Tuin 29 (1930) 132; BURK. & HANIFF, Gard. Bull. S. S. 6 (1930) 240; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 232, f. 120 L–O; BURK. Dict. 2 (1935) 2156; DING HOU, Blumea 27 (1981) 311, f. 5–7. — *Lobbia dependens* PLANCH. in Hook. Lond. J. Bot. 6 (1847) 144, t. 3; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1068. — **Fig. 1b.**

Erect shrub, up to 2.5 m high. Branches subterete, c. 0.5 cm ø, glabrous. *Leaves* chartaceous, elliptic, obovate, rarely ovate, 12–29 by 5–15 cm; apex acuminate; base cuneate or acute; glabrous above, sparsely puberulous or pubescent, sometimes seemingly glabrous beneath; basal nerves 2 pairs, the inner one similar to lateral nerves, extending upward to about halfway, the outer one weak, short, close to



Fig. 6. *Thottea penitilobata* DING HOU. a. Habit,  $\times \frac{1}{2}$ , b. basal part of flowering stem,  $\times \frac{1}{2}$ , c. inflorescence, nat. size, d–e. flowers,  $\times 2$ , f. gynostemium,  $\times 5$ . — *T. muluensis* DING HOU. g. Inflorescence on stem,  $\times \frac{1}{2}$ , h. flower, nat. size, i. gynostemium,  $\times 5$  (a–f ARGENT c.s. 691, g–i ARGENT c.s. 760). Courtesy of Blumea.

the margin; lateral nerves 6–9 pairs, elevated and prominent below, less so above; veins transverse or  $\pm$  parallel and reticulate, slightly elevated on both surfaces; petiole 5–10 mm, glabrous. *Inflorescences* at the basal part of the stem, in the axils of leaves or fallen leaves, or cauliflorous, simple or sparsely branched, up to 4 (–7) cm long, pubescent; bracts lanceolate, oblanceolate or elliptic, 6–9 mm long, densely puberulous on both surfaces. Pedicel and ovary 7–15 mm long, pubescent. *Perianth* pale yellow with center and margin streaked with claret-colour, brown, deep reddish pink, dark purple outside and pink inside, or purple; campanulate, contracted at the lower 1/3 and then erecto-patent, 15–25 mm long, c. 25 mm  $\phi$ , glabrous on both surfaces; tube urceolate, c. 10 mm long; lobes triangular, 6–10 (–15) by 10–15 (–25) mm, acute, each with longitudinal (c. 7) and reticulate veins. *Stamens* in 2 whorls: upper row 7–10, lower 13–16; filaments glabrous, 1–2 mm; anthers oblong, c. 1.5 mm long. *Style* column c. 4 mm long; lobes (4–) 6–9, spreading, c. 3 mm long. *Capsules* slender, 5–10 cm long, 4-angular, straight or slightly twisted at the apical part. *Seeds* ellipsoid, trigonous, 3–4 mm long, acute at both ends, rugose-tubercled.

*Distr. Malesia:* Malay Peninsula (Perak, Dinings, Trengganu, Pahang, Selangor, Penang, Singapore).

*Ecol.* In forest, up to c. 500 m. *Fl.* March–Oct., *fr.* Jan.–Nov.

*Uses.* Leaves used as medicine for cutaneous disease.

*Vern.* *Tlinga berwang*, Perak.

*Note.* See also the note under the Bornean *T. muiluensis*.

**15. *Thottea reniloba* DING HOU, Blumea 27 (1981) 326, f. 19, 20, 53. — Fig. 2g.**

Erect subshrub, up to 2.5 m high. Branches  $\pm$  curved, terete or slightly compressed, 0.5–1 cm  $\phi$ , pubescent. *Leaves* chartaceous, oblanceolate, lanceolate, or elliptic, 15–29 by 5.5–14 cm; apex acuminate; base cuneate or obtuse; glabrous, sometimes slightly pubescent on the midrib above, loosely pubescent beneath; basal nerves 2 pairs, the inner one starting near the base, ascending up to 2/3 or higher, similar to the lateral ones in thickness and appearance, the outer one weak and short, close to the margin; lateral nerves 5–8 pairs, occasionally with shorter ones between them, elevated beneath, faint above; veins transverse, scalariform, connected with crossbar-like or loosely reticulate veinlets, slightly elevated below, flat or obscure above; petiole 4–10 mm, pubescent. *Inflorescences* in the axils of foliage leaves, simple or sparsely branched, up to 8.5 cm long, spici- or racemiform, internodes spacious, puberulous; bracts oblanceolate to spatulate, or nar-

row-elliptic, 3–7 mm long, puberulous on both surfaces. Pedicel and ovary rather long, 14–30 mm, puberulous. *Perianth* dirty purplish red, or dark brown, short-cupular, 10–13 mm long, 15–20 mm  $\phi$ , veins rather loosely reticulate, sparsely puberulous outside, slightly (glandular) hairy inside; tube 5–6 mm long; lobes reniform, 5–7 by 11–20 mm, margin reflexed at anthesis. *Stamens* in 2 whorls: upper row 9–12, lower 9–14; filaments glabrous, very short; anthers oblong, c. 1 mm long. *Style* column short, c. 1.5 mm long; lobes 8 or 9, c. 2 mm, glabrous. *Capsules* (rather young) pendent, siliquiform, twisted, narrowed at both ends, puberulous. *Seeds* ellipsoid, c. 2.5 by 1.5 mm, tubercled, deeply furrowed.

*Distr. Malesia:* Northern Sumatra (Atjeh: Gunung Leuser Nature Reserve; Tapanuli: Div. Padang; East Coast: Asahan and Upper Bila).

*Ecol.* In lowland forest, at base of steep sandstone rock or over basalt rock, up to 125 m. *Fl.* April–Sept., *fr.* July.

*Note.* The flowers remind of *T. borneensis*; differs from that species by loosely pubescent (not densely sericeous) leaf undersurface, venation at base reticulate (not transverse), rachis with spaced bracts and long internodes, perianth without a distinct annular fold or ridge inside the mouth of the tube, and reniform lobes.

**16. *Thottea penitilobata* DING HOU, Blumea 27 (1981) 324, f. 14–16, 72A. — Fig. 6a–f.**

Erect shrub, c. 1 m high. Branches terete, c. 0.5 cm  $\phi$ , slightly puberulous, glabrescent. *Leaves* chartaceous, oblanceolate or elliptic, (12–) 16–22 by 5–9.5 cm; apex acuminate; base cuneate or slightly obtuse; glabrous above, sparsely puberulous beneath; basal nerves 2 pairs, the inner one similar to the lateral nerves, emerging near the base and obliquely ascending halfway, the outer one very weak, short, and close to the margin; lateral nerves 4–7 pairs, elevated beneath, distinct above; veins transverse or scalariform, connected by transverse or reticulated veinlets, slightly elevated beneath, visible or rather obscure above; petiole 0.5–0.7 cm, subterete, sparsely puberulous. *Inflorescences* near the basal part of the stem, in axils of reduced leaves, simple or rarely with short branches, spiciform, 3–6.5 cm long, puberulous; bracts ovate or lanceolate, 2–7 mm long, puberulous on both surfaces. Pedicel and ovary c. 6 mm long, sparsely puberulous. *Perianth* c. 15 mm long, deeply lobed, sparsely puberulous outside, glabrescent, densely (glandular) papillate on the inner surface except glabrous at the apical and marginal parts of the lobe; veins invisible outside, obscurely reticulate near marginal parts of lobes; tube very short; lobes broad-ovate or suborbiculate, 10–12 by c. 11 mm, acute, short-acuminate, or obtuse. *Stamens* in 2 whorls: upper row 10, lower c. 14; filaments glabrous, very



short; anthers oblong, c. 1.25 mm long. *Style* column short; lobes (6–) 10–14, 1.5–2 mm, glabrous. Capsules unknown.

Distr. *Malesia*: Borneo (Sarawak: 4th Div., Gunong Mulu Nat. Park; Kalimantan: Kalteng Prov.); twice collected.

Ecol. On bank at riverside in lowland rain-forest and in primary dipterocarp forest, 40–150 m. *Fl.* Nov., Jan.

Vern. *Kayu manis*, Kalimantan.

Note. Closely allied to *T. muluensis*, from which it cannot be separated in sterile state, but quite different in flower structure: perianth 1.5 cm long, deeply lobed, with broad or suborbicular lobes; 10–12 style lobes; in *T. muluensis* the perianth is 3.7–4.5 cm long, only lobed halfway, with triangular lobes; 7 style lobes.

**17. *Thottea celebica*** DING HOU, *Blumea* 27 (1981) 318, f. 21, 22, 70A. — **Fig. 7a–e.**

Erect undershrub, up to 70 cm high. Branches terete, 5–7 mm  $\varnothing$ , pubescent. *Leaves* chartaceous to coriaceous, 22.5–32 by 6.5–9 cm; apex acuminate; base obtuse; glabrous above, sparsely puberulous beneath; basal nerves 2 pairs, the inner one branching from the midrib c. 4 mm above the base and extending upward to about halfway, the outer one much weaker and shorter and close to the margin; lateral nerves c. 10 pairs; veins transversal or reticulate; nerves and veins elevated and prominent beneath, less so above; petiole short, c. 0.5 cm, puberulous. *Inflorescences* at the base of the stem, simple, spiciform, 5.5 cm long, puberulous; bracts elliptic, 4–8 mm long, sometimes 2-lobed, puberulous on both surfaces. Pedicel and ovary c. 12.5 mm long, puberulous. *Perianth* dark purplish red, campanulate, c. 25 mm long, c. 30 mm  $\varnothing$ , with several longitudinal veins distinct outside, obscure inside, puberulous, glabrescent outside, glandular hairy inside, especially at the lower 1/3; tube cupular, the lower half contracted and cylindric (c. 6 mm long); lobes semi-orbicular, c. 10 by 15 mm, subrotund or slightly apiculate at the apex. *Stamens* in 2 whorls: upper row 10–12, lower 12–15; filaments glabrous, 1–2 mm; anthers 1–1.7 mm long. *Style* column c. 1 mm long; lobes c. 12, erect, c. 2 mm long. *Capsules* (very young) slender, 4-angular, twisted, c. 4 cm long, sparsely puberulous.

Distr. *Malesia*: Central Celebes (Lambarese, NE. Palopo); once collected.

Ecol. Open shady places in forest at low altitude. *Fl.* & very young *fr.* July.

Note. The only species so far known from Celebes. Allied to *T. philippinensis*, which has a closely reticulate prominent venation underneath the leaves, a slightly shorter perianth not contracted in the lower third, and 4–6 style lobes against c. 12 in *T. celebica*.

**18. *Thottea muluensis*** DING HOU, *Blumea* 27 (1981) 322, f. 72B. — **Fig. 1c, 6g–i.**

Erect shrub, c. 1 m high. Branches terete, c. 6 mm  $\varnothing$ , glabrous. *Leaves* chartaceous, elliptic, lanceolate, or oblanceolate, 15–29 by 5–12 cm; apex acute to acuminate; base cuneate; glabrous above, sparsely puberulous beneath; basal nerves one pair, emerging slightly above the base and ascending to about halfway; lateral nerves 6–10 pairs; nerves elevated and prominent below, flat and distinct above; veins transverse, scalariform, connected with loosely reticulated veinlets, elevated below, visible or obscure above; petiole c. 1 cm, sparsely puberulous. *Inflorescences* at the basal part of the stem or near the ground, usually in the axils of bracts, single or sparsely branched near the base, racemiform, 12–14 cm long, puberulous; bracts lanceolate, 5–10 mm long, puberulous on both surfaces. Pedicel and ovary 9–11 mm long, puberulous. *Perianth* dark purplish or dark purplish maroon, campanulate, 37–45 mm long, with longitudinal and reticulate veins, sparsely puberulous on both surfaces; tube 17–20 mm long; lobes triangular, 20–25 by c. 20 mm, acuminate. *Stamens* in 2 whorls: upper row 9, lower 12; filaments glabrous, very short, c. 1.3 mm; anthers oblong, 0.7–1 mm long. *Style* column c. 3 mm long; lobes 7, c. 1.5 mm, glabrous. Capsules unknown.

Distr. *Malesia*: Borneo (Sarawak: Gunong Mulu Nat. Park).

Ecol. Somewhat open position in lowland forest, c. 35 m. *Fl.* Oct.–Nov.

Uses. Said to be used for birth control by Punan people.

Note. Allied to *T. dependens* which has, however, the undersurface of the leaf covered by papillae forming rings or loops and a glabrous perianth. See also note under *T. penitilobata*.

**19. *Thottea corymbosa*** (GRIFF.) DING HOU, *Blumea* 27 (1981) 320, f. 4. — *Bragantia corymbosa* GRIFF. Trans. Linn. Soc. 19 (1845) 335; Ann. Sc. Nat. Bot. 7 (1847) 340; Miq. Fl. Ind. Bat. 1, 1 (1858) 1068; KLOTZSCH, Monatsb. Akad. Berl. (1859) 591, t. 1, f. 4; DUCHARTRE in DC. Prod. 15, 1 (1864) 429; Hook. f. Fl. Br. India 5 (1886) 73; SOLEREDER, Bot. Jahrb. 10 (1889) 431. — *Asiphonia piperiformis* GRIFF. Trans. Linn. Soc. 19 (1845) 333; Ann. Sc. Nat. Bot. 7 (1847) 338; Notul. 4 (1854) 344; Icon. Pl. Asiat. 4 (1854) t. 528, f. 1. — *Strakaea melastomaefolia* PRESL, Epim. Bot. (1851) 221. — *Asiphonia* sp. GRIFF. Notul. 4 (1854) 346; Icon. Pl. Asiat. 4 (1854) t. 528, f. 2. — *Bragantia melastomaefolia* DUCHARTRE in DC. Prod. 15, 1 (1864) 429; WARBURG, Pflanzenwelt 1 (1913) 521. — *Apama corymbosa* (GRIFF.) WILLD. ex SOLEREDER in E. & P. Nat. Pfl. Fam. 3, 1 (1889) 272; O.K. Rev. Gen. Pl. 1 (1891) 563; KING &

GAMBLE, J. As. Soc. Beng. 75, ii (1912) 25; MOORE, J. Bot. 63 (1925) 83; HEYNE, Nutt. Pl. (1927) 596; BURK. Dict. 1 (1935) 188; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 233; HEND. Mal. Wild Fl. (1951) 420, f. 382A-C. — **Fig. 1a, 8d.**

Shrub, spreading, sometimes scrambling, up to 5 m high. Branches terete, up to 2 cm  $\phi$ , densely puberulous. *Leaves* chartaceous or subcoriaceous, ovate to lanceolate, elliptic or elliptic-oblong, sometimes obovate, 6.5–17.5 by 2.5–8.5 cm; apex cuspidate or acuminate; base cuneate, rounded or obtuse; upper surface glabrous except scattered puberulous on the midrib, nerves and veins, lower surface puberulous; basal nerves 2 pairs, the inner one as prominent as the midrib (the leaf appearing as 3-ribbed), ascending upward and reaching often to the apical part of the blade, the outer one much weaker, close to the margin, shorter than the inner one; lateral nerves 0–3 pairs, when present usually at the upper half of the blade; veins transverse, parallel ( $\pm$  perpendicular to the midrib), joined by crossbar-like or loosely reticulate veinlets; nerves and veins elevated and prominent beneath, slightly elevated and rather fine above; petiole subsessile to c. 8 mm, puberulous. *Inflorescences* terminal and/or axillary in the upper leaf-axils, few- and lax-branched, panicleiform or corymbose, up to 10 cm long, puberulous; bracts subulate or linear, up to 8 mm long, puberulous. Pedicel and ovary 7–20 mm, puberulous. *Perianth* yellow, greenish or cream coloured outside, pale lilac inside, 3–3.5 mm long, when spreading c. 7 mm  $\phi$ , densely puberulous outside, glabrous inside, veins invisible, deeply 3-lobed; lobes broad-ovate or suborbicular, 2.5–3 by 2.5–3.5 mm, apex acute. *Stamens* in 1 whorl, 7–10, rarely more; filaments 0 or obscure; anthers oblong, c. 1 mm long, covered with short, hooked hairs. *Style* column obscure, lobes 4, glabrous. *Capsules* slender, long, up to 38 cm long, 4-angular, slightly twisted, puberulous. *Seeds* ovoid, trigonous, 4–6 by 2.5–3.5 mm, rugose.

*Distr.* *Malesia*: Widely distributed but scattered in Sumatra and the Malay Peninsula (incl. Penang); Borneo (Kalimantan: Bukit Kasian), once collected.

*Ecol.* In forest, sometimes on the edge of forest, occasionally in shaded forest in limestone zone, from the lowland up to 1050 m. *Fl. fr.* all the year round.

*Uses.* Pounded leaves are put inside the hollow of the tooth to remedy toothache. The central part of the roots is chewed along with betel-nut as a diuretic, if needed, during confinement (BURKILL, l.c.).

*Vern.* Sumatra: (*andor*) *lasi*, *bandar puluh*, Asahan, *kadudu rimbu*, Djambi, *subie siang*, Riouw (Kuala Belilas). Malay Peninsula: *akar chambai olar*, *a. julong bukit*, *a. serai*, *andor lasi*, *bunga changi ular*, *èkor pelandok*, *jangat*, *lerkor*, *mahjar pahit*, *tin-jau biuti*, M.

**20. *Thottea tomentosa* (BL.) DING HOU**, *Blumea* 27 (1981) 328, f. 48, 49. — *Ceramium tomentosum* BL. Bijdr. (1826-27) 1135. — *Bragantia tomentosa* BL. En. Fl. Jav. (1827) 82; BENN. in Benn. & Brown, Pl. Jav. Rar. 1 (1838) 43, t. 11; GRIFF. Trans. Linn. Soc. 19 (1845) 336; LINDL. Veg. Kingd. (1846) 794; GRIFF. Ann. Sc. Nat. Bot. 7 (1847) 340; ZOLL. Syst. Verz. 2 (1854) 118; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1068; DU-CHARTRE in DC. Prod. 15, 1 (1864) 431; HOOK. f. Fl. Br. India 5 (1886) 73, incl. *var. lanuginosa* HOOK. f.; CLARKE, J. Linn. Soc. Bot. 25 (1889) 61; SOLEREDER, Bot. Jahrb. 10 (1889) 431; RIDL. J. Str. Br. R. As. Soc. n. 57 (1910) 89; *ibid.* n. 59 (1911) 161. — *Vanhalia tomentosa* J.A. & J.H. SCHULTES, Syst. Veg. 7 (1829) 166. — *Bragantia blumii* LINDL. Bot. Reg. 18 (1832) *sub* t. 1543, in note; Veg. Kingd. (1846) 793, f. 526. — *Cyclodiscus tomentosus* KLOTZSCH, Monatsb. Akad. Berl. (1859) 592. — *Apama tomentosa* ENGL. ex SOLEREDER in E. & P. Nat. Pfl. Fam. 3, 1 (1889) 272; O. K. Rev. Gen. Pl. 1 (1891) 563; KING & GAMBLE, J. As. Soc. Beng. 75, ii (1912) 25, incl. *var. lanuginosa* (HOOK. f.) K. & G. l.c. 26; BACK. Trop. Natuur 7 (1918) 179, f. 1–4; *ibid.* 8 (1919) 164; BEUMÉE, *ibid.* 8 (1919) 15; RIDL. Fl. Mal. Pen. 3 (1924) 15; MOORE, J. Bot. 63 (1925) Suppl. 83; KOORD. Exk. Fl. Java 4 (Atlas) (1926) 589, f. 871; HEYNE, Nutt. Pl. (1927) 596; STEEN. Bull. Jard. Bot. Btzg III, 12 (1932) 204; BURK. Dict. 1 (1935) 189; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 234, f. 120A–G; KANJILAL C.S. Fl. Assam 4 (1940) 30; HEND. Mal. Wild Fl. (1951) 423, f. 382E; BACK. & BAKH. f. Fl. Java 1 (1963) 162. — *Bragantia affinis* PLANCH. ex ROLFE, Kew Bull. (1913) 265; MERR. En. Philip. 2 (1923) 120. — *Bragantia brevipes* MERR. Philip. J. Sc. 17 (1920) 248; En. Philip. 2 (1923) 120. — *Apama affinis* WEISSE, Ber. Deut. Bot. Ges. 45 (1927) 235; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 234. — *Apama brevipes* WEISSE, Ber. Deut. Bot. Ges. 45 (1927) 235; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 234.

Subwoody herb, from creeping base erect to erecto-patent, 10–35 cm; stems one to several or sometimes many together, usually simple. Branches rather slender, c. 5 mm  $\phi$ , bearing 1–5 (often 2 or 3) foliage leaves at the apical part, furrowed or slightly angular, tomentose. *Leaves* chartaceous or subcoriaceous, variable in shape and size even on one plant, ovate, elliptic or broadly elliptic, elliptic-oblong, obovate or oblanceolate, rarely suborbiculate, (4–) 7–18 (–24) by (1.7–) 3–15 (–17) cm; apex acute, acuminate, or obtuse; base obtuse, rounded, sometimes subcordate or cordate; glabrous above, densely pubescent, tomentose or villous beneath especially when young, sometimes glabrescent; basal nerves 2, rarely 3 pairs, starting from the base and ascending upward to more than halfway, similar to the lateral nerves, the outer 1 or 2 rather faint and short, close

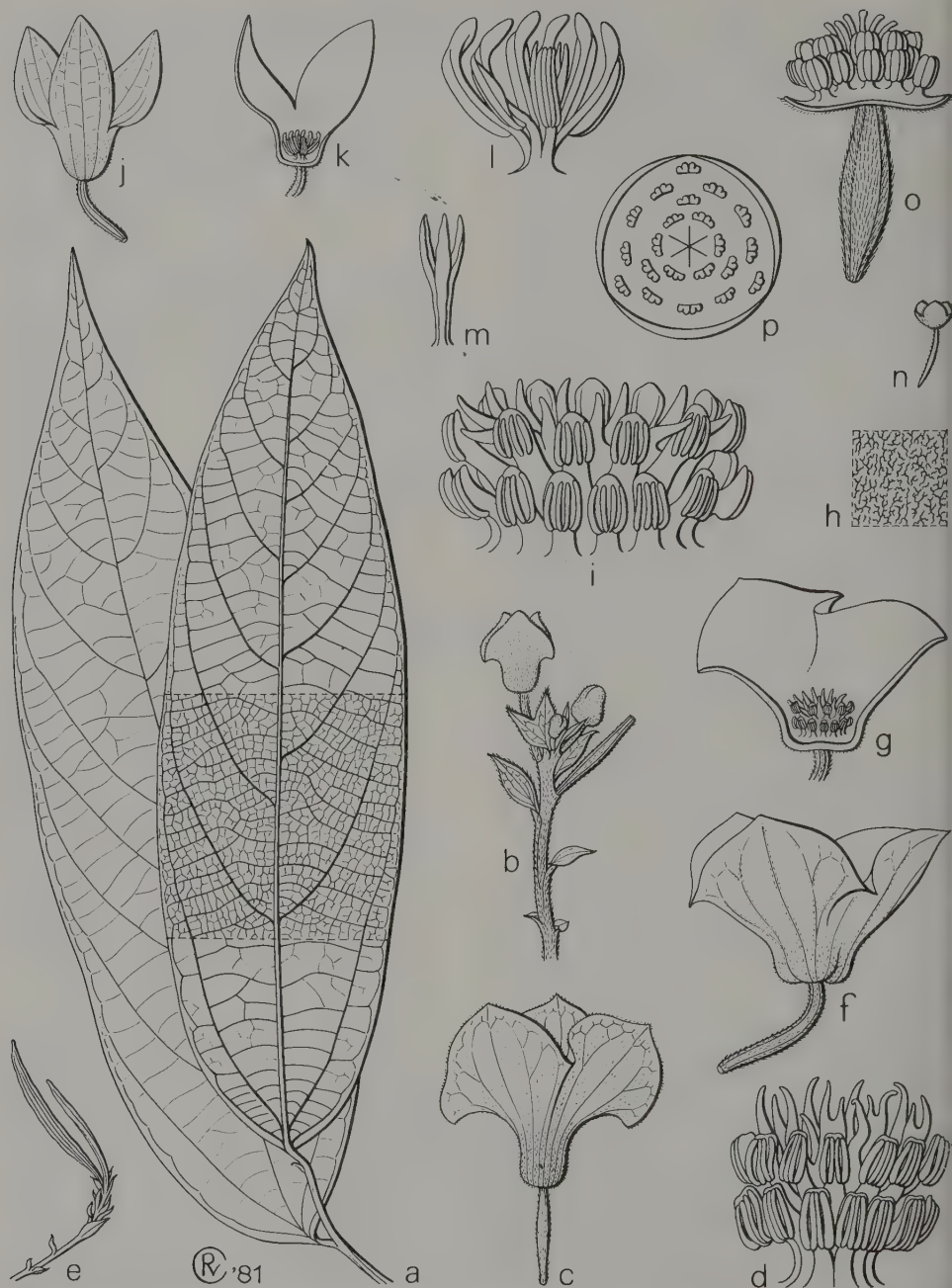


Fig. 7. *Thottea celebica* DING HOU. *a*. Habit,  $\times \frac{1}{2}$ , *b*. inflorescence, *c*. flower, nat. size, *d*. gynostemium,  $\times 5$ , *e*. young infructescence,  $\times \frac{1}{2}$ . — *T. tricornis* MAINGAY. *f*–*g*. Flowers, nat. size, *h*. indument of inner surface of perianth,  $\times 10$ , *i*. gynostemium,  $\times 5$ . — *T. sumatrana* (MERR.) DING HOU. *j*–*k*. Flowers, nat. size, *l*. gynostemium,  $\times 5$ , *m*. 3-lobed style,  $\times 5$ . — *T. parviflora* RIDL. *n*. Flower, nat. size, *o*. *ditto*, perianth removed,  $\times 5$ , *p*. floral diagram showing 4 whorls of stamens (*a*–*e* STRAATMAN *s.n.*, *f*–*i* VAN BALGOOY 2627, *j*–*m* KOSTERMANS 284, *n* VAN BEUSEKOM & PHENGKLAH 694, *o*–*p* GEESINK & SANTISUK 5101). Courtesy of Blumea.



to the margin; lateral nerves 4–9 pairs, joined by rather closely reticulate and loosely crossbar-like veins and veinlets, elevated beneath, distinct sometimes obscure above; petiole 5–15 mm, pubescent. *Inflorescences* near the base of the branches, sometimes hidden under fallen leaves, in the axils of bracts or not well developed (small) leaves, often simple and spiciform, up to c. 12 cm long, pubescent; bracts lanceolate to linear, up to c. 10 mm long, pubescent. Pedicel and ovary 8–22 mm long, densely pubescent. *Perianth* pale yellow, yellow with purple, purple, pale red, or red (colour changing with age of the flower), urceolate-campanulate, 6–12.5 mm long, 12–16 mm  $\emptyset$ , with longitudinal and loosely reticulate veins, pubescent outside, glabrous inside; tube 3–5 mm long, with a thin 'disk' adnate to the inner side, slightly protruding above the tube (c. 0.5 mm) like a narrow rim; lobes broadly ovate, suborbicular, or subreniform, 3–7.5 by 4–8 mm. *Stamens* 6, in 1 whorl; filaments glabrous, 1–1.5 mm; anthers oblong, 1.5–2 mm long, connective slightly produced beyond the anthers. *Style* column c. 2 mm long; lobes 3 (or 4), 1.5–2 mm, hairy often at the apical part. *Capsule* slender, 3.5–5 (–15), often obscurely 4-angular, pubescent, glabrescent. *Seeds* oblong, trigonous, c. 4 by 2 mm, rugose.

*Distr.* India (Assam: Manipur & S. Andaman Is.), Bangladesh (Sylhet), Burma (Moulmein), South Vietnam (Bien Hoá), Peninsular Thailand; in *Malesia*: Malay Peninsula (throughout), Sumatra, West & Central Java, and Philippines (Jayabas, Alabat I., Panay, Mindanao), not yet found in Borneo. Cultivated in Hort. Bog. n. XI-B-XIII-138.

*Ecol.* In shady, moist places in forest, sometimes in bamboo or teak forest, occasionally in secondary forest, rarely on limestone, locally sometimes common, from the lowland up to 1200 m. *Fl. fr.* often all the year round.

*Uses.* In Malaya the plant is used for poulticing skin-complaints and boils (along with *Illigera*). In Java the stems and leaves may be pounded and the juice swallowed for coughs. The roots and leaves are used as a diuretic during confinement. In W. Java also used against snake-bites (BURKILL, l.c.; HEYNE, l.c.).

*Vern.* Malay Peninsula: *kaneb*, *kemed*, *serèng-kong*, M. Java: *singa dapur*, *s. depa*, J; *kaliwaro*, *singa depa*, S.

*Notes.* *T. tomentosa* is the widest ranging species of the genus. It is the only species in Java.

Fruits are surprisingly rare and hitherto accepted as indehiscent. However, in a Thailand collection it had split with 4 valves.

The species is allied to the Indian *T. siliquosa* (LAMK) DING HOU and the Bornean *T. paucifida* (see note under the latter); *T. siliquosa* has 9 stamens in 3 groups, the anthers dorsally and the style lobes densely hooked-hairy.

**21. *Thottea macrantha* (BOERL.) DING HOU**, Blumea 27 (1981) 321. — *Bragantia macrantha* BOERL. Handl. 3 (1900) 64; VALET. Icon. Bog. 3 (1908) sub t. 260, *emend.* — *Apama macrantha* WEISSE, Ber. Deut. Bot. Ges. 45 (1927) 234, in obs.; STEEN. Bull. Jard. Bot. Btzig III, 12 (1932) 204; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 234, f. 120H–J. — *T. hirsuta* RIDLEY, J. Mal. Br. R. As. Soc. 1 (1923) 87. — **Fig. 2e–f.**

Herb woody at base, or shrub-like, up to 4 m high. Branches terete, 5–7 mm  $\emptyset$ , pubescent or hirsute. *Leaves* chartaceous to subcoriaceous, obovate to oblanceolate, elliptic-oblong, or lanceolate, (13–) 25–36 (–41) by (5–) 8–12.5 (–21) cm; apex short-acuminate or acuminate, sometimes apiculate, base cuneate; glabrous above, pubescent beneath; basal nerves 2 or 3 pairs, the inner one starting from the base or c. 5 mm above it, ascending upward and reaching to more than halfway, similar to the lateral nerves, the outer 1 or 2 much weaker and shorter, close to the margin; lateral nerves 7–10 pairs, elevated and prominent beneath, slightly elevated or flat above; veins transverse, scalariform, some loosely reticulate, joined by weaker crossbar-like or loosely reticulate veinlets, slightly elevated beneath, visible or obscure above; petiole 5–8 (–15) mm, hirsute. *Inflorescences* axillary, 1–3, often in axils of foliage leaves, simple or sparsely branched, spiciform or racemiform, rarely paniculiform, up to 7 cm long, pubescent; bracts oblanceolate, those at the lower part shorter, pubescent outside, glabrous inside. Pedicel and ovary 15–18 mm, pubescent. *Perianth* reddish or dark brown and puberulous outside, white and glandular-hairy inside, campanulate, c. 20 mm long and wide; tube c. 8 mm long; lobes broadly rounded, c. 12 by 4 mm, emarginate, reflexed. *Stamens* in 1 whorl, 9–12, patent or reflexed; filaments c. 3.5 mm, glabrous; anthers oblong, 1.2–2 mm long. *Style* column short, lobes 9–12, c. 2 mm, glabrous. *Capsules* erect, elongate, up to 11 cm long, 4-angular, pubescent, glabrescent. *Seeds* ellipsoid, c. 3 by 1.5 mm, transverse-rugose.

*Distr.* *Malesia*: Northern Sumatra (Atjeh, Sibolangit, Taram, Ketambe, Deli, Asahan). Cultivated in Hort. Bog. sub n. XI-B-XIII-133.

*Ecol.* In primary and young forest, mostly on slopes, sometimes in secondary forest, rare, sometimes locally abundant, in lowland up to 450 m. *Fl. fr.* Feb.–Sept.

*Vern.* *Ambolas tombak*, Asahan.

*Note.* RIDLEY described *T. hirsuta* to have 2 whorls of stamens, but the single flower of the type I examined has the stamens in one whorl.

**22. *Thottea sumatrana* (MERR.) DING HOU**, Blumea 27 (1981) 328, f. 70C. — *Apama sumatrana* MERR. Pap. Mich. Ac. Sc. 23 (1937) 178. — **Fig. 7j–m.**

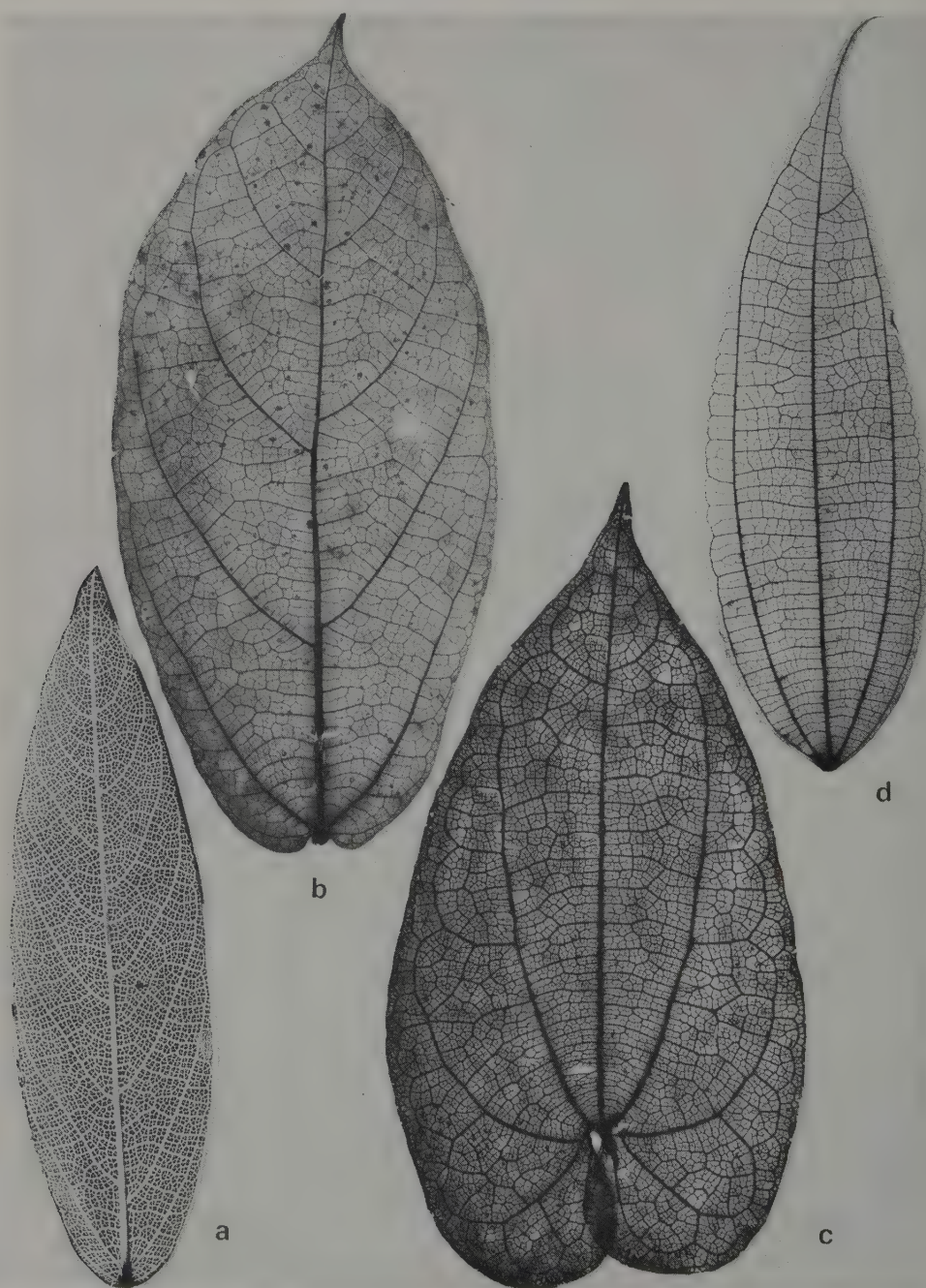


Fig. 8. Samples illustrating leaf venation patterns: *a* & *c* densely reticulate, *b* loosely reticulate, *d* trabeculate.  
 — *a*. *Thottea philippinensis* QUIS.,  $\times 2/3$  (FB 30249). — *b*. *Aristolochia momandul* SCHMIDT,  $\times 3/5$  (NGF 27848). — *c*. *A. crassinervia* SCHMIDT,  $\times 4/5$  (NGF 45343). — *d*. *Thottea corymbosa* (GRIFF.) DING HOU,  $\times 2/3$  (Hou 732). (*a* undersurface of not cleared leaf, *b*–*d* cleared leaves).



Herb woody at base, shrub-like, up to 1 m high. Branches sulcate or irregularly angular, c. 5 mm  $\phi$ , sparsely pubescent. *Leaves* chartaceous, elliptic, lanceolate, obovate, rarely oblanceolate, 10–21 by 4.5–7.5 cm; apex acute, acuminate, or short-acuminate; base obtuse, rotund, or cuneate; glabrous above, pubescent beneath; basal nerves 2 or 3 pairs, the inner one ascending upward to about halfway, similar to the lateral nerves, the outer 1 or 2 much weaker and shorter, close to the margin; lateral nerves 8–14 pairs, joined by transverse, subparallel, scalariform or sometimes loosely reticulate veins and veinlets, elevated beneath, often obscure above, petiole 3–5 (–10) mm, pubescent. *Inflorescences* axillary, usually in the axils of foliage leaves, spiciform or racemiform, solitary or rarely 2 in an axil, pubescent; bracts crowded, lanceolate, elliptic, oblanceolate or spatulate, 3–10 mm long, pubescent outside, glabrous inside. Pedicel and ovary 5–10 mm long, pubescent. *Perianth* dirty yellowish white, inside blackish red, or dark-red, campanulate, or funnel-shaped, 14–20 mm long, c. 12 mm  $\phi$ , veins loosely reticulate, sparsely puberulous outside, glabrous inside; tube c. 5 mm long; lobes ovate to lanceolate, 8–15 by 5–8 mm, apex acute, acuminate, or obtuse. *Stamens* 6, in 1 whorl; filaments glabrous, c. 1 mm;

anthers oblong, c. 1 mm long (excl. the protruding connective). *Style* column c. 2 mm long, lobes 3, 1–2 mm, glabrous. *Capsules* slender, up to 16 cm long, cylindric or slightly angular, twisted, sparsely pubescent. *Seeds* ovoid, trigonous, c. 4.5 by 2.5 mm, transversely rugose.

*Distr.* Peninsular Burma (Ta Pe) and Peninsular Thailand (Pattani and near Neckey); in *Malesia*: Northern Sumatra (Tapanuli: Padang Lawas; East Coast: Laut Tador & Gedong Biara Estates) and N. Malay Peninsula (Perlis and Kedah).

*Ecol.* In lowland forest, by stream, on sandy loam soil, up to c. 150 m. *Fl. fr.* April–August.

*Note.* Sterile specimens are difficult to identify. In flower easily recognized by a deeply lobed perianth, 6 stamens in one whorl, anthers with a protruding connective, and 3 style-lobes.

Insufficiently known

*Thottea* sp. DING HOU, *Blumea* 27 (1981) 329.

In Kalimantan (Sg. Dingen) JAHERI (n. 790, BO) collected an as yet undescribed species. It resembles *T. tomentosa*, but the single immature flower possesses 2 whorls of stamens. Better material is needed for a proper description.

## 2. ARISTOLOCHIA

LINNÉ, *Sp. Pl.* (1753) 960; KLOTZSCH, *Monatsb. Akad. Berlin* (1859) 593; DUCHARTRE in DC. *Prod.* 15, 1 (1864) 432; SCHMIDT in E. & P. *Nat. Pfl. Fam.* ed. 2, 16b (1935) 235; HOEHNE, *Fl. Bras.* 15 (1942) 23; PFEIFER, *Ann. Mo. Bot. Gard.* 53 (1966) 122; *Tax. Rev. Pentam. Sp. Aristolochia* (1970) 15; DING HOU, *Blumea* 29 (1983) 223. — **Fig. 1, 2, 8–18.**

Herbaceous perennials, undershrubs or shrubs, usually scandent, scrambling, twining, or climbing, sometimes high lianas, often with prostrate or tuberous rhizomes or rootstocks; vegetative parts upon breaking or only the flowers often with a bad, mostly putrid smell. (Old) woody stems mostly with a thick-corky and fissured bark, showing broad, medullary rays on cross-section. *Leaves* entire, sometimes 3-lobed (irregularly up to 7-lobed in extra-Malesian *spp.*). Petiole grooved above. *Flowers* usually zygomorphic, rarely actinomorphic, solitary, fasciculate, or in inflorescences (cymose, racemose, spicate, paniculate), axillary or cauligerous. *Perianth* straight, curved, or S-shaped, inflated at the basal part (utricle), then contracted or narrowed above in an often cylindric or funnel-shaped part (tube), gradually elongated, enlarged and expanded into the 1-lipped or 3 (–6)-lobed limb, the utricle often inside provided with 2 (–6) glandular bodies. *Stamens* mostly 6 (4, 5, or more in extra-Malesian *spp.*) (10 in the Malesian *A. decandra*), adnate to the style column in a gynostemium. *Ovary* oblong or elongate, slightly 6-angular and 6-celled (5-celled in extra-Malesian *spp.*); style column mostly 6-lobed (5-lobed in extra-Malesian *spp.*). Fruits capsular,



6-celled (5-celled in extra-Malesian *spp.*), dehiscent (dehiscing usually acropetally, rarely basipetally: *A. singalagensis*) or indehiscent (*A. dielsiana*?, and extra-Malesian *spp.*). *Seeds* ovate, deltoid, or triangular, often winged, flat, convex-concave, or slightly longitudinally curved; testa crustaceous or hard, finely verrucose or smooth; funicle often fleshy, thickened, usually covering the whole seed, usually persistent on the seed as an elaiosome, membranous when dry.

*Distr.* About 400 species, widely distributed mainly throughout the tropics and subtropics and some in the warm temperate regions, also in Australia; throughout *Malesia*: 28 species.

*Ecol.* Usually scattered, only rarely locally abundant, in primary forests, sometimes in (old) secondary forests or in thickets, occasionally occurring in beach or swampy forest, limestone regions, or submontane to montane forest; mostly at low and medium altitudes, sometimes found higher, above 1500 m, up to 2250 m (in Papua New Guinea).

For the relation with butterflies, pollination in relation to flower morphology, seed dispersal, *etc.*, I refer to the general chapters.

*Morph.* See the general chapters, also for chromosomes, phytochemistry, anatomy and palynology.

*Uses.* See the general chapters.

*Notes.* In the key and descriptions the pedicel and ovary are taken as a whole, like under *Thottea*, because these organs merge imperceptibly.

For the diameter of the floral tube, only the cylindric middle part is used for size.

In general flowering material is necessary for correct identification.

In Malesia a number of exotic species is cultivated; a dozen of these are entered in the key by BACKER & BACK-HUIZEN *f.*, *Flora of Java* 1 (1963) 162–164.

For convenience of identification, local keys for islands have been added to the general key.

GENERAL KEY TO THE SPECIES  
based on fertile specimens

1. Leaves deeply 3-lobed, in shape reminding of the letter 'W'.
  2. Leaf base shallowly concave, subcordate, or almost truncate, rarely cuneate. Inflorescences with small, not amplexicaul bracts c. 1.5 mm long. Seeds distinctly winged ..... **1. *A. jackii***
  2. Leaf base cuneate. Inflorescences with conspicuous, amplexicaul bracts 7–10 (–15) mm long. Seeds not winged ..... **2. *A. curtisii***
1. Leaves never deeply 3-lobed as above, mostly entire.
  3. Leaves villous or densely tomentose underneath, often concealing the surface (especially when young).
    4. Perianth limb distinctly 3-lobed; lobes triangular, 3 by 4.5–6 cm, obtuse. (Fruit dehiscing from the apex downward; seeds strongly convex-concave) ..... **3. *A. singalagensis***
    4. Perianth limb rim-like, the limb 0.5–1 cm wide, obscurely 3-lobed. (Fruit unknown) ..... **10. *A. coadunata***
  3. Leaves shortly, minutely, or sparsely hairy on the undersurface (surface always exposed), or glabrous on both surfaces.
    5. Leaves glabrous on both surfaces.
      6. Leaf base subtruncate, slightly concave, obtuse, or rounded, sometimes slightly cuneate. (Seeds not winged).
        7. Plants erect, up to c. 1 m high. Leaves with pinnately arranged lateral nerves. Petiole less than 1 (–2) cm long. Perianth 1-lipped ..... **18. *A. philippinensis***
        7. Twiners or stout climbers, up to 15 m high. Leaves palmately nerved. Petiole 3–12 cm long.
          8. Leaves distinctly papillate beneath; 5-nerved, joined by reticulate veins. Flowers 1-lipped ..... **13. *A. papillifolia***
          8. Leaves smooth beneath; 3- or 5-nerved, joined by  $\pm$  transverse veins. Flowers unknown ..... **14. *A. transtillifera***
      6. Leaf base subcordate or cordate (usually adult leaves), or subtruncate (especially when young in *A. gaudichaudii*).
        9. Perianth puberulous outside; limb narrow-elliptic, 5–6 cm long ..... **22. *A. leytensis***
        9. Perianth glabrous outside; limb obovate to oblanceolate, 1.7–2.5 cm long.
          10. Perianth tube 8–12 mm long; limb obovate or oblanceolate, 17–20 mm long. Fruits oblong 4–6 by c. 3 cm. Seeds winged ..... **27. *A. gaudichaudii***

10. Perianth tube 16–19 mm long; limb obovate-oblong, 20–25 mm long. Fruits unknown **8. A. klossii**
5. Leaves shortly, minutely, or sparsely hairy on the undersurface.
11. Plants erect, up to c. 1 m high.
12. Petiole (20–) 30–40 mm long. Seeds verrucose only on the marginal part beneath, smooth above **19. A. humilis**
12. Petiole at most 10 mm long. Seeds verrucose on both surfaces.
13. Leaf base obtuse or rounded, subacute or cuneate. Perianth with reflexed tube **17. A. samarensis**
13. Leaf base distinctly cordate, sometimes slightly cordate, very rarely associated with some obtuse ones. Perianth straight, sometimes slightly curved.
14. Leaf base deeply cordate, auricles often overlapping or surrounding the stem **20. A. macgregorii**
14. Leaf base slightly cordate, rarely associated with some obtuse ones, auricles obscure or 0 **21. A. sericea**
11. Twiners or lianas, much taller, up to many metres high.
15. Perianth 6- or 3-lobed.
16. Perianth 6-lobed ..... **24. A. schlechteri**
16. Perianth 3-lobed.
17. Perianth 19–21 cm long. Stamens 10. Style-column 10-lobed. Leaves suborbicular or broad-ovate, deeply cordate, palmately 5- or 7-nerved ..... **16. A. decandra**
17. Perianth less than 9 cm long. Stamens 6. Style column 6-lobed.
18. Flower buds or perianth lobes with the apical 20–30 mm strongly contracted or narrowed and often tail-like when dry (easily broken).
19. Perianth lobes suborbicular, c. 10 mm  $\varnothing$ , with an apical tail-like part c. 20 mm long **11. A. momandul**
19. Perianth lobes triangular to narrow-triangular, 35–50 by 12–14 mm at the bases (apical 25–30 mm often tail-like when dry) ..... **25. A. dielsiana**
18. Flower buds or perianth lobes without a tail-like apical part as above. Perianth lobes triangular, 5–6 by 8–10 mm, apex obtuse or retuse ..... **26. A. engleriana**
15. Perianth 1-lipped.
20. Leaf base often rounded or obtuse, not cordate.
21. Inner pair of basal nerves reaching nearly the leaf apex joined by 10–14 pairs of loose, transverse or slightly curved cross-veins. Perianth without a stipe; limb ovate-oblong or lanceolate, 6–9 by 3–3.5 cm ..... **15. A. naviculilimba**
21. Leaves with 1 pair of basal nerves reaching upward to about halfway; lateral nerves 4 or 5 pairs, obliquely ascending to the margin. Perianth with a distinct stipe of 5 mm; limb oblong, much smaller, 2.7 by 0.7 cm ..... **12. A. rumphii**
20. Leaf base cordate or subcordate.
22. Leaf veins and veinlets closely reticulate or foveolate-reticulate, prominent beneath. Cf. fig. 8c.
23. Perianth with a distinct stipe of 3–5 mm. Seeds winged. Leaves variable in shape and size **5. A. zollingeriana**
23. Perianth without a stipe. Seeds not winged.
24. Perianth limb ovate-oblong, 30 by 14–16 mm. Seeds triangular, c. 5 by 4 mm, verrucose on both surfaces ..... **4. A. foveolata**
24. Perianth limb linear, 20 by 4 mm. Seeds triangular or deltoid, 7 by 6–7 mm, rather smooth or obscurely muriculate on both surfaces. .... **23. A. crassinervia**
22. Leaf veins and veinlets loosely reticulate, distinct or obscure beneath. Cf. fig. 8b.
25. Leaves triangular or deltoid. (Leaves palmately 5-nerved. Perianth with a distinct stipe of c. 2.5 mm. Seeds winged) ..... **28. A. linnemannii**
25. Leaves often ovate, ovate-oblong, or lanceolate.
26. Leaves with 3–5 pairs of lateral nerves from the midrib, obliquely ascending. Perianth with a distinct stipe.
27. Perianth limb 20–30 (–40) mm long. Seeds winged ..... **9. A. tagala**
27. Perianth limb 50–60 mm long (ripe seeds unknown) ..... **22. A. leytenis**
26. Leaves without lateral nerves from the midrib. Perianth without a stipe.
28. Basal nerves 2 (or 3 pairs), the inner pair ascending upward to c. 2/3 of the blade. Flowers small: utricle 3–6 mm long, tube 2.5–5 mm long, limb 11–12 mm long . **6. A. minutiflora**
28. Basal nerves 1 pair, ascending upward to the apex. Flowers larger: utricle 10–12 mm long, tube 5–11 mm long, limb 15–25 mm long. .... **7. A. glaucifolia**

## KEY TO THE SPECIES

*Sumatra, Malay Peninsula and neighbouring islands*

1. Leaves deeply 3-lobed, in shape often reminding of the letter 'W'.
2. Leaf base shallowly concave, subcordate, or almost truncate, rarely cuneate. Inflorescences with small, not amplexicaul bracts (c. 1.5 mm long). Seeds distinctly winged ..... 1. *A. jackii*
2. Leaf base cuneate. Inflorescences with conspicuous amplexicaul bracts (7–10, rarely up to 15 mm long). Seeds not winged ..... 2. *A. curtisii*
1. Leaves entire.
3. Leaves villous or densely tomentose underneath, often concealing the surface (especially when young).
4. Perianth limb distinctly 3-lobed; lobes triangular, 3 by 4.5–6 cm, obtuse. (Fruit dehiscing from the apex downward; seeds strongly convex-concave) ..... 3. *A. singalagensis*
4. Perianth limb rim-like, the limb 0.5–1 cm wide, obscurely 3-lobed. (Fruit unknown) ..... 10. *A. coadunata*
3. Leaves shortly, minutely, or sparsely hairy underneath (surface always exposed), or glabrous.
5. Leaf veins and veinlets closely reticulate or foveolate-reticulate, prominent beneath.
6. Perianth without a stipe. Seeds not winged ..... 4. *A. foveolata*
6. Perianth with a distinct stipe of 3–5 mm. Seeds winged ..... 5. *A. zollingeriana*
5. Leaf veins and veinlets loosely reticulate, distinct or obscure beneath.
7. Perianth without a stipe. Seeds not winged. (Leaves thin-chartaceous).
8. Leaves palmately 5 (–7)-nerved, papillate beneath ..... 6. *A. minutiflora*
8. Leaves 3-curvinerved, with irregular (finely reticulate, wax) thickenings and scattered black dots (secretory cells) beneath ..... 7. *A. glaucifolia*
7. Perianth with a distinct stipe. Seeds winged. (Leaves chartaceous).
9. Leaf with the two basal lobes widely separate from each other (sinus 7–9 cm wide at the base). Perianth limb obovate-oblong, 10–14 mm wide; apex slightly retuse or mucronate ..... 8. *A. klossii*
9. Leaf with the two basal lobes close to each other or often connivent at the base. Perianth limb lanceolate to narrowly lanceolate, 6–8 mm wide; apex acute ..... 9. *A. tagala*

## KEY TO THE SPECIES

*Java, Lesser Sunda Is., Moluccas, Celebes and neighbouring islands*

1. Leaves deeply 3-lobed, in shape often reminding of the letter 'W' ..... 1. *A. jackii*
1. Leaves entire.
2. Leaves villous or densely tomentose on the undersurface. Perianth with the tube bent backward and contacting closely laterally with the utricle; limb rim-like, obscurely 3-lobed ..... 10. *A. coadunata*
2. Leaves shortly or minutely hairy beneath. Perianth straight or slightly curved; limb distinctly 3-lobed or 1-lipped.
3. Flower buds with a distinct, long tail-like apex c. 20 mm long (easily broken when dry). Limb distinctly 3-lobed. Capsules oblong or ellipsoid, 5.5–9 by 3.5–4 cm, strongly 6-ridged. (Seeds not winged, rather smooth on both surfaces) ..... 11. *A. momandul*
3. Flower buds without a long tail-like apex. Limb 1-lipped. Capsules short-cylindric, subglobose, slightly pyriform, or oblong, 2–4 by 1.5–3 cm, often slightly 6-ridged.
4. Leaf base obtuse, sometimes slightly cuneate, rarely truncate. Seeds not winged ... 12. *A. rumphii*
4. Leaf base cordate. Seeds winged.
5. Leaf veins and veinlets closely reticulate, densely covered with minute hairs beneath (examining with a hand lens or under the dissecting microscope). Perianth lobes obovate-oblong, 25–30 by 10 mm, longitudinally reflexed at anthesis. Seeds 4–5 by 4 mm (incl. the c. 0.6 mm broad wing) ..... 5. *A. zollingeriana*
5. Leaf veins and veinlets loosely reticulate, sparsely shortly hairy or (nearly) glabrous beneath. Perianth lobes lanceolate to narrowly lanceolate, 20–30 (–40) by 6–8 mm, not longitudinally reflexed at anthesis. Seeds 8.5–10 mm long and wide (incl. the c. 2 mm broad wing) ..... 9. *A. tagala*

## KEY TO THE SPECIES

*Borneo*

1. Leaves deeply 3-lobed, in shape often resembling the letter 'W' ..... 1. *A. jackii*
1. Leaves entire.



2. Leaf base not cordate, but obtuse or rounded, shallowly concave, subtruncate, or slightly cuneate.
3. Leaves glabrous beneath.
  4. Leaves distinctly papillate beneath (handlens or binocular), 5-nerved, joined by reticulate and transverse veins ..... 13. *A. papillifolia*
  4. Leaves not papillate beneath, 3 (–5)-nerved, joined by transverse veins ..... 14. *A. transtillifera*
3. Leaves minutely hairy beneath especially on the venation ..... 15. *A. naviculilimba*
2. Leaf base distinctly cordate.
  5. Petiole 10–13 cm long. Flowers large: utricle 5–6 cm long, tube c. 5 cm long, limb 4–9 cm long, 3-lobed. Stamens 10 ..... 16. *A. decandra*
  5. Petiole much shorter. Flowers much smaller. Perianth 1-lipped. Stamens 6.
    6. Leaf veins and veinlets closely foveolate-reticulate, prominent beneath. Utricle with 6 (or 2) glandular bodies inside. (Seeds not winged) ..... 4. *A. foveolata*
    6. Leaf veins and veinlets loosely reticulate or transverse, distinct or rather faint beneath. Utricle with 2 glandular bodies inside.
      7. Leaf undersurface papillate (under the binocular). Perianth without a stipe; utricle 3–6 mm long, tube 2.5–5 mm long, limb 11–12 mm long. Seeds not winged ..... 6. *A. minutiflora*
      7. Leaf undersurface not papillate. Perianth with a distinct stipe; utricle 3–9 mm long, tube 5–10 (–15) mm long, limb 20–30 (–40) mm long. Seeds distinctly winged ..... 9. *A. tagala*

KEY TO THE SPECIES

*Philippines*

1. Leaves deeply 3-lobed, in shape often resembling the letter 'W' ..... 1. *A. jackii*
1. Leaves entire, very rarely remotely minutely toothed (*A. philippinensis*).
2. Leaf base obtuse or rounded, subacute, or cuneate. (Plants erect, up to c. 1 m high).
  3. Perianth with tube and limb bent backward and parallel to the utricle. Utricle 35 mm long, tube 10–15 mm long, limb 45 mm long. Seeds verrucose on both surfaces. Petiole 6–10 mm long ..... 17. *A. samarensis*
  3. Perianth straight. Utricle 6–7 mm long, tube 5–15 mm long, limb 18–25 mm long.
    4. Leaves glabrous on both surfaces. Petiole 4–8 (–20) mm long. Seeds verrucose beneath and marginal part above ..... 18. *A. philippinensis*
    4. Leaves glabrous above, sparsely short-hairy beneath. Petiole (20–) 30–40 mm long. Seeds verrucose only on the marginal part beneath, smooth above ..... 19. *A. humilis*
2. Leaf base distinctly cordate, sometimes slightly or shallowly cordate, very rarely associated with some obtuse ones (*A. sericea*).
5. Erect plants up to 1 m high. Petiole 2–10 mm long.
  6. Leaf base deeply cordate; auricles often overlapping or surrounding the stem .. 20. *A. macgregorii*
  6. Leaf base slightly or shallowly cordate, rarely associated with some obtuse ones; auricles obscure or 0 ..... 21. *A. sericea*
5. Twiners or climbers. Petiole 20–70 mm long.
  7. Leaf veins and veinlets foveolate-reticulate, prominent beneath. Utricle with 6 (or 2) glandular bodies inside. Seeds not winged ..... 4. *A. foveolata*
  7. Leaf veins and veinlets often loosely, rarely closely, reticulate, or transverse, distinct or rather faint beneath. Utricle with 2 glandular bodies inside. Seeds distinctly winged (not known in *A. leytenensis*).
    8. Leaf veins and veinlets (closely reticulate) densely covered with minute hairs beneath (handlens or binocular). Seeds (proper) verrucose on both surfaces ..... 5. *A. zollingeriana*
    8. Leaf veins and veinlets (loosely reticulate) sparsely short-hairy or (nearly) glabrous beneath.
      9. Perianth tube 20 mm long, limb 50–60 mm long. Mature seeds not known ..... 22. *A. leytenensis*
      9. Perianth tube 5–10 (–15) mm long, limb 20–30 (–40) mm long. Seeds verrucose beneath, less so above ..... 9. *A. tagala*

KEY TO THE SPECIES

*New Guinea and neighbouring islands*

1. Leaves deeply 3-lobed, in shape often reminding of the letter 'W' ..... 1. *A. jackii*
1. Leaves entire.
  2. Leaf veins closely reticulate, prominent beneath. Fruits cylindric or oblong, 2.5–4.5 by 2–3 cm, minutely granular. Leaves cordate, auricles usually much overlapping; apex acuminate .... 23. *A. crassinervia*

2. Leaf veins loosely reticulate and some crossbar-like, often slightly elevated beneath.
3. Perianth limb 6-lobed. (Leaf base cordate)..... 24. *A. schlechteri*
3. Perianth limb 3-lobed or 1-lipped.
4. Perianth without a stipe; limb 3-lobed. Seeds not winged.
5. Flower buds or perianth lobes with the apical 20–30 mm strongly contracted or narrowed and often tail-like when dry (easily broken).
6. Perianth lobes suborbicular, c. 10 mm  $\phi$ , with an apical tail-like apex c. 20 mm long  
11. *A. momandul*
6. Perianth lobes triangular to narrow-triangular, 35–50 by 12–14 mm at the base, apical 25–30 mm often tail-like when dry..... 25. *A. dielsiana*
5. Flower buds or perianth lobes without a tail-like apical part. Perianth lobes triangular, 5–6 by 8–10 mm, apex obtuse or retuse..... 26. *A. engleriana*
4. Perianth with a distinct stipe; limb 1-lipped. Seeds distinctly winged.
7. Leaves glabrous. Perianth limb obovate or oblanceolate, 17–20 by 8–12 mm. Seeds (incl. wing) transverse-oblong, 6–11.5 by 12–16 mm, smooth on both surfaces..... 27. *A. gaudichaudii*
7. Leaves minutely hairy or sparsely short-hairy beneath. Seeds (incl. wing) triangular, 6–10 by 5–10 mm, usually verrucose on both surfaces.
8. Leaves triangular or deltoid in outline, minutely hairy beneath. Inflorescences 2–3 (–15) mm long; internodes condensed, obscure or invisible; bracts minute, c. 1 mm long. Perianth lobes oblong, c. 20 mm long..... 28. *A. linnemannii*
8. Leaves variable in shape and size, ovate, ovate-oblong, rarely suborbicular, sparsely shortly hairy beneath. Inflorescences 20–60 mm long; internodes spacious, distinct; bracts up to 10 mm long. Perianth lobes lanceolate, 20–30 (–40) mm long..... 9. *A. tagala*

1. *Aristolochia jackii* STEUD. Nom. Bot. ed. 2, 1 (1840) 132; MIQ. Sum. (1860) 150; DING HOU, Blumea 29 (1983) 230. — *A. hastata* JACK, Malay Misc. 2, 7 (1822) 6 [reimpr. in Hook. J. Bot. 1 (1834) 362; GRIFF. Calc. J. Nat. Hist. 4 (1843) 358; TRÜBNER, Oriental Series II, 2 (1887) 249], *nom illeg.*, non H.B.K. (1817), *nec* NUTTALL (1818); KLOTZSCH, Monatsber. Akad. Berl. (1859) 597, JACK *sphalm.* as JACQUIN, excl. ZOLLINGER 2744; DUCHARTRE in DC. Prod. 15, 1 (1864) 482; MERR. J. Arn. Arb. 33 (1952) 217. — *A. unguifolia* MASTERS, J. Linn. Soc. Bot. 14 (1875) 494; Gard. Chron. n.s. 14 (1880) 116, f. 28; HOOK. f. in Curtis' Bot. Mag. 121 (1895) t. 7424; RIDLEY, J. Str. Br. R. As. Soc. n. 33 (1900) 126; KING & GAMBLE, J. As. Soc. Beng. 75, ii (1912) 30; SCHMIDT, Bot. Jahrb. 58 (1923) 488; RIDLEY, Fl. Mal. Pen. 3 (1924) 18; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; HEND. Mal. Nat. J. 6 (1951) 422, f. 381C. — *A. tripartita* BACK. Trop. Natuur 8 (1919) 161 & 165, f. 14; Bull. Jard. Bot. Btzg III, 2 (1920) 322; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; BACK. & BAKH. f. Fl. Java 1 (1963) 162. — Fig. 9.

Undershrub, spreading or twining, up to 10 m high. Branches obscurely angular, 3–5 mm  $\phi$ , glabrous. Leaves chartaceous or subcoriaceous, broadly or transversely ovate or suborbicular in outline, 11–23 by 15–24 cm, deeply 3-lobed, in shape often reminding of the letter 'W', glabrous; base emarginate, subcordate, or almost truncate, rarely cuneate; midlobe usually obovate- or ovate-oblong, 5.5–20 by 6.5–10 cm, apex obtuse or acute, rarely short acuminate; lateral lobes oblong, falcate or semilunar,

curved upward, sometimes spreading almost horizontally, 4–15 by 2.5–6 cm, rounded or obtuse at the apex; midrib with 2 or 3 pairs of lateral nerves; basal nerves 2, each once or twice branched (the leaf seemingly 5–7-nerved); nerves elevated and prominent beneath, rather less so above; veins loosely transverse or reticulate, slightly elevated on both surfaces; petiole 2–7 cm, glabrous. Inflorescences in axils of foliage leaves, spiciform or racemiform, up to c. 7 (–25) cm long, internodes distinct; bracts rather loose, ovate, c. 1.5 mm long, glabrous beneath, short-hairy above. Pedicels and ovary 1.5–3 cm, glabrous. Perianth purple-brown or -red, or purple, slightly curved, 7.5–11 cm long, glabrous outside; utricle ellipsoid or obovoid, 2–3.5 cm long, with a stipe of 6–7 mm, inside hairy, with 2 ellipsoid, glandular bodies; tube 2–3.5 cm long, hairy inside; limb 1-lipped, oblong or ovate-oblong, elliptic, or spatulate, erect or reclined, 3.5–4.5 by 2–2.5 cm, tomentose or villous on the upper surface and mouth of the tube. Stamens 6; anthers ellipsoid-oblong, c. 1.5 mm long. Style column 5–7 mm long, 6-lobed; lobes conical, with a prominent annular ring at their base. Capsules oblong, 5–6 by 2.5 cm, 6-angular, glabrous. Seeds triangular-orbicular, 4–5 by 5–7 mm (excl. wing), lower surface smooth except a few warts at the apical and basal ends, upper surface slightly ridged at the centre; marginate, the wing 3–5 mm wide.

Distr. *Malesia*: N. Sumatra (Medan, Sibolangit, Asahan, Natal), Malay Peninsula (Pahang, Jarak I. in Malacca Strait, Singapore), Java (Preanger, Nusa Kambangan I., Mt Wilis), Borneo: Sabah (Labuan,

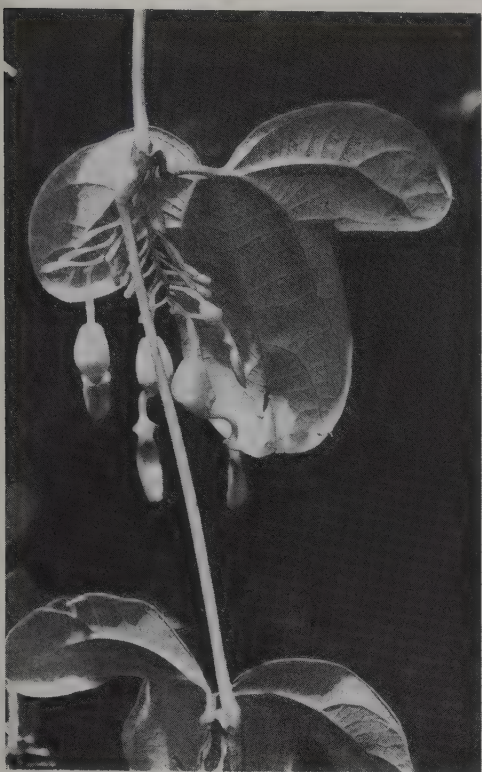


Fig. 9. *Aristolochia jackii* STEUD. NW. Kalimantan, near Njarumkop (Photogr. Father A. ELSENER, H52, Oct. 1964).

Tuaran), NW. Kalimantan (Njarumkop), SW. Philippines (N. Palawan), New Guinea (?) (Sepik and Madang Distr.). Cultivated in Hort. *sub n.* XV-D-46.

Ecol. In forest, sometimes in swampy forest behind the sea coast, from sea level up to 1200 m. *Fl.* Feb., June, Nov., *fr.* Jan., Feb., April, Sept., Oct.

Vern. Sabah: *tawayagon*, Tuaran; New Guinea: *bagup*, Sepik.

Notes. Closely related to *A. curtisii*, sharing deeply digitately 3-lobed leaves, spaced flowers and bracts, and a 1-lipped perianth, but easily distinguished from it by a truncate, emarginate or subcordate leaf base, much smaller bracts (c. 1.5 mm), a longer perianth (7.5–11 cm), and winged seeds.

Professor JUMALON (Cebu-city, Philippines), who raised plants from seeds from Palawan, recorded that leaves can attain 50 by 30 cm, or even more.

**2. *Aristolochia curtisii* KING**, Ann. Bot. Gard. Calc. 5 (1896) 161, t. 195; GAMBLE, Kew Bull. (1910) 78;

KING & GAMBLE, J. As. Soc. Beng. 75, ii (1912) 32; RIDLEY, Fl. Mal. Pen. 3 (1924) 18; DING HOU, Blumea 29 (1983) 227.

Climber up to 5 m high. Branches obscurely sulcate or slightly angular, c. 3 mm  $\phi$ . *Leaves* chartaceous, deeply 3-lobed (broadly hastately 3-lobed when young), 10–23 by 10–30 cm; base cuneate; glabrous on both surfaces; middle lobe oblanceolate, 8–18 by 2–6.5 cm, acuminate; lateral lobes spatulate, slightly incurved, 6.5–14 by 2.5–5.5 cm, rounded at the apex; nervation pedately flabellate, 3-nerved at the base; outer nerves at first along the margin, then giving off: a) 2 interior nerves to the central lobe and each of them ascending upwards to the apex, and b) often 2 exterior nerves for each of the outer lobes, respectively, extending to the apex; midrib and nerves elevated and prominent beneath, rather less so above; veins loosely transverse and reticulate, distinct beneath, rather faint above; petiole 5–10 cm, subterete. *Inflorescences* in the axils of foliage leaves, 1–3, spiciform, up to 6.5 cm long, glabrous, internodes distinct; bracts amplexicaul, conspicuous, reddish, ovate to lanceolate, 7–10 (–15) mm long, glabrous. Pedicel and ovary 6–8 mm long, glabrous. *Perianth* blue and crimson, straight, with obscure venation, glabrous; utricle ellipsoid, 20 by 8 mm; tube cylindric, 10 by 1 mm; limb 1-lipped, linear, 20 by 1 mm. *Stamens* 6, filaments with very small anthers. *Style* column very short, 6-lobed. *Capsules* oblong, 3–4 by 1.5 cm, obscurely 6-ribbed, obtuse. *Seeds* broad-ovate, not winged, c. 5 by 4 mm, granular on both surfaces, funicle spindle-shaped, c. 4.5 by 2 mm.

Distr. Peninsular Thailand (Khaw Pok Hill, Khsoon) and in *Malesia*: Malay Peninsula (Penang).

Ecol. In dense forest, 150–450 m. *Fl.* March, *fr.* June–August.

Note. Closely allied to *A. jackii* STEUD.

**3. *Aristolochia singalangensis* KORTH. ex DING HOU**, Blumea 29 (1983) 224, f. 1, 2a, 3c & d, 7a.

Liana up to 20 m high. Stems terete or slightly flattened, 1–1.5 (rarely more) cm  $\phi$ ; branchlets tomentose or villous, glabrescent. *Leaves* subcoriaceous, suborbicular, broadly ovate, sometimes ovate, rarely ovate-oblong, (14–) 24–33 by (6–) 11–24 cm; apex acuminate or shortly so; base cordate, sinus 1.5 (–3) cm deep; upper surface pubescent on the midrib and nerves; undersurface villous or densely tomentose, glabrescent; basal nerves one pair reaching upward to halfway or higher; lateral nerves pinnate, 4 or 5 pairs, prominent beneath, distinct, sometimes depressed above; veins crossbar-like or reticulate, slightly elevated with distinct areoles beneath, rather obscure above; petiole stout, terete, (3–) 6–14 cm, c. 5 mm  $\phi$ , villous or tomentose, glabrescent. *Inflorescences* cauligerous, solitary, racemiform, axis c. 4 cm



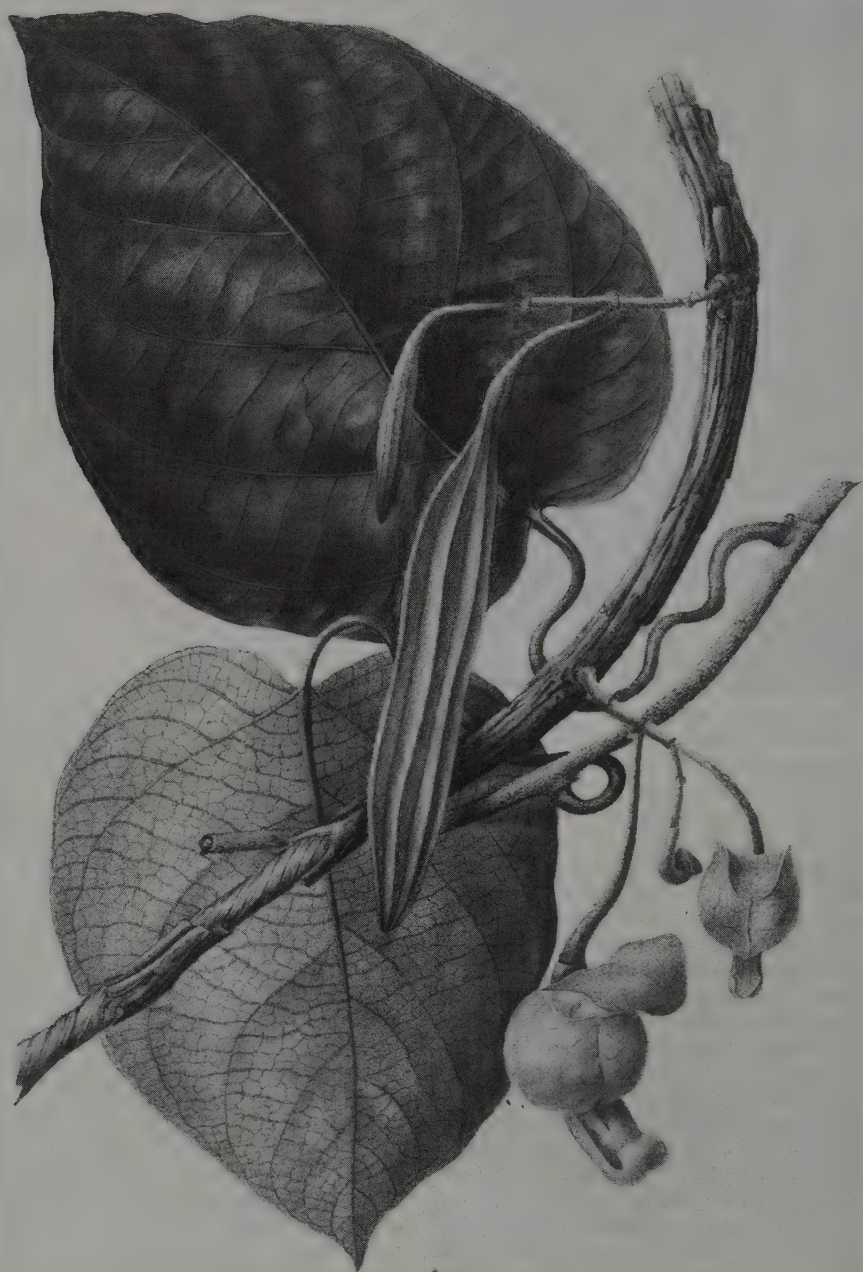


Fig. 10. *Aristolochia singalagensis* KORTH. ex DING HOU. Photograph of a coloured drawing in L made after the living plant; leaves  $\times 1/3$ , twig with flowers and fruit  $\times 1/2$ .

long, internodes spacious, tomentose or densely pubescent; bracts small, triangular, c. 3 mm long, densely pubescent. Pedicel and ovary up to 7 cm long, tomentose or pubescent. *Perianth* pale yellowish green, pubescent outside; utricle cylindric, c. 7 by 1–1.5 cm, the apical 1–1.5 cm strongly bent backward; tube cylindric, 4 by 0.6–1.2 cm, closely parallel to the utricle; limb deeply 3-lobed, lobes triangular, 3 by 4.5–6 cm, apex obtuse. Stamens and style column unknown. *Capsules* elongate-oblong, 14–15 by 2.5–3 cm, 6-ridged, dehiscent from the apex downward, tomentose or pubescent. *Seeds* convex on the lower side and ovoid-like in side view or seen from beneath, not winged, c. 8 by 5 mm, deeply concave on the upper side with a prominent, central, longitudinal, septum-like funiculus, testa smooth on both surfaces.

*Distr. Malesia:* Sumatra (Atjeh, near Pematang Siantar, Mt Singalang, Palembang).

*Ecol.* At edge of grassy marshland in the forest, along a trail in depleted forest, and on flat forest ridge, (c. 350–) 750–1700 m.

*Taxon.* *A. singalangensis* is closely allied to the Himalayan *A. griffithii* DUCHARTRE and the Chinese *A. kwangsiensis* LIANG with which it shares all essential structural characters of the leaves, flowers, fruit and seed. It can be distinguished from them by the different size of the flora parts and the deeply 3-lobed perianth, of which the lobes are pale yellowish green on the inner surface (not pinkish purple or purple).

Sterile specimens may resemble *Phytocrene* species (*Icacinaceae*), but can readily be distinguished by the absence of an abscission zone in the petiole, hence leaving no scar after withering.

Style column and stamens are as yet unknown.

**4. *Aristolochia foveolata* MERR.** Philip. J. Sc. 13 (1918) Bot. 280; En. Philip. 2 (1923) 119; IGARASHI, Food Pl. Papilionidae (1979) t. 26 (fig. on the lower right) & 27, as *Aristolochia* sp. 2; LIU & LAI, Quart. J. Taiwan Mus. 33 (1980) 247; DING HOU, Blumea 29 (1983) 227. — *A. kanoi* LIU & LAI, Fl. Taiwan 2 (1976) 573, t. 411; Hsu (ed.), The Rare & Threatened Plants of Taiwan (1980) 45, col. phot.

Twinner up to 10 (–40) m high. Old stems terete, 1.5–2 cm  $\varnothing$ , bark corky, longitudinally fissured or ridged. Branches terete, 2–6 mm  $\varnothing$ , striate, glabrous. *Leaves* chartaceous to coriaceous, ovate to lanceolate in outline, sometimes broad-ovate, rarely sub-orbicular, 7–18 (–24) by (3–) 4–8 (–21) cm; apex acuminate, rarely cuspidate; base cordate, sinus 1–2.5 cm deep, sometimes auriculate with auricles overlapping, rarely shallowly cordate, concave, or subtruncate (especially when young); glabrous above, densely puberulous beneath; nervation palmate, appearing as 5 (–7)-nerved; inner pair of

nerves nearly reaching the apex; outer pair much shorter, branched at the base with 1 or 2 branches extending to the margin or auricles; nerves prominent beneath, distinct above, joined by closely foveolate-reticulate and crossbar-like veins and veinlets; veins and veinlets slightly elevated and prominent beneath, distinct or rather faint above; petiole 2–4 (–7.5) cm, glabrous. *Inflorescences* in axils of leaves or cauligerous, often with very short branches, internodes hardly visible and flowers almost fasciculate; bracts lanceolate, 4–5 mm long, minutely hairy on both surfaces. Pedicel and ovary 28–40 mm long, slightly twisted, glabrous. *Perianth* maroon or purple-brown, at first straight or horizontal then curved, veins faint, glabrous outside, with scattered, glandular hairs inside; utricle subglobose, c. 7 mm  $\varnothing$ , not stiped, with 6 (or 2) glandular, ellipsoid bodies (c. 2 by 1 mm) (6, rarely 2, depressions shown on the outer surface); tube 10–14 by 2.5 mm; limb 1-lipped, ovate-oblong, 30 by 14–16 mm. Gynostemium c. 2.5 mm long. *Stamens* 6; anthers oblong, c. 1 mm long. *Style* 6-lobed, lobes triangular, 1.5 mm long, with an annular ring at the base. *Capsules* cylindric or obovoid, not angular or ridged, 2.5–4 by 1.5 cm, glabrous (minutely granulate examined with hand lens). *Seeds* triangular, c. 5 by 4 mm, not winged, verrucose on both surfaces; funicle broadened, membranous, and covering the upper surface.

*Distr.* China (Taiwan); in *Malesia*: NE. Sumatra, Malay Peninsula (Trengganu), Borneo (Sabah: Mt Kinabalu, Sandakan; Sarawak: Upper Rejang R. and Kuching; Kalimantan: Landak R.), Philippines (Catanduanes and Palawan). Fig. 11.

*Ecol.* In primary, sometimes in secondary forest, often at low and medium altitudes, sometimes found at 1500–2100 m. *Fl.* May–Aug., Dec., *fr.* May, Oct., Dec.

*Taxon.* The species resembles *A. tagala* in leaf

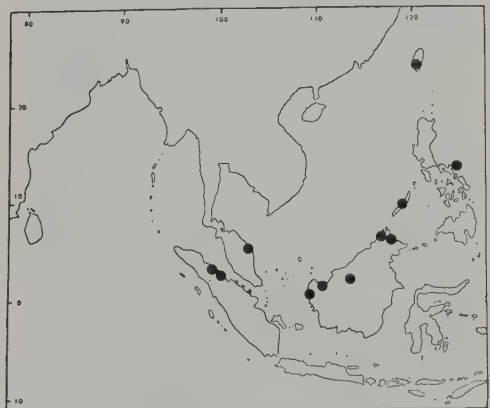


Fig. 11. Localities of *Aristolochia foveolata* MERR.

shape (usually with cordate base) and the 1-lipped perianth but is easily to distinguish from that species by the palmate nervation of the leaves, the undersurface being distinctly foveolate-reticulate and densely puberulous, the perianth which is not strongly contracted and stipe-like at base, and the immarginate seeds.

**Notes.** The leaves are rather variable in shape and size (ovate to lanceolate, rarely suborbicular, and  $l = 7/3, 9\frac{1}{2}/5, 12/9, 18/11, 24/21$  cm) and leaf base (deeply cordate with auricles sometimes overlapping to cordate or subtruncate). This variability may well occur in one specimen, as was observed in the field and in specimens which I cultivated.

The species is often collected by entomologists as the larvae of the butterfly *Trogonoptera brookiana* feed on it. Near Berastagi (NE. Sumatra) it is even locally cultivated for this purpose.

**5. *Aristolochia zollingeriana* Miquel.** Fl. Ind. Bat. 1, 1 (1858) 1066; DUCHARTRE in DC. Prod. 15, 1 (1864) 482; BACK. Trop. Natuur 8 (1919) 162, f. 15, 165; KOORD. Exk. Fl. Java 4 (Atlas) (1926) 591, f. 873; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; BACK. & BAKH. f. Fl. Java 1 (1963) 162; DING HOU, Blumea 29 (1983) 232, f. 2c, 3a & b. — *A. hastata* (non JACK, sphalm. as JACQUIN) KLOTZSCH, Monatsb. Akad. Berl. (1859) 597, *quoad* ZOLLINGER 2744. — *A. ramosii* MERR. Philip. J. Sc. 29 (1926) 478. — *A. kankauensis* SASAKI, Trans. Nat. Hist. Soc. Form. 21 (1931) 251; LIU & LAI, Fl. Taiwan 2 (1979) 572; Hsu (ed.), The Rare & Threatened Plants of Taiwan (1980) 45, col. phot. — *A. roxburghiana* ssp. *kankauensis* (SASAKI) KITAMURA, Acta Phytotax. Geobot. 20 (1962) 135. — *A. tagala* (non CHAMISSO) HATUS. Fl. Ryukyu (1971) 243; WALKER, Fl. Okin. S. Ryukyu Is. (1976) 424. — *A. tagala* var. *kankauensis* (SASAKI) YAMAZAKI, J. Jap. Bot. 50 (1975) 341, as '*hankaensis*'.

Undershrub or a twiner up to 5 m high. Branches terete, c. 3 mm  $\phi$ , sulcate, glabrous. Leaves chartaceous, variable in shape and size even on one specimen, ovate or ovate-oblong, sometimes deltoid, reniform, or suborbicular, 4–15 by 2.5–12 cm; apex usually acuminate, rarely acute or obtuse; base cordate or shallowly cordate, sometimes sagittate, auricles separate from each other, rounded at the end, sinus 1–3 cm deep, glabrous above, minutely puberulous beneath; midrib and basal nerves palmately 5-nerved, the midrib with 1–3 pairs of lateral nerves; basal nerves 2 pairs, the inner pair ascending to 2/3, sometimes almost to the apex of the blade, the outer pair much shorter, spreading toward the margin at the basal part of the blade, each of them with a few side branchlets; nerves slightly elevated beneath, distinct or sometimes rather faint; veins closely reticulate, some transverse, distinct or sometimes rather

faint beneath; petiole 2–5 (–7) cm, glabrous. *Inflorescences* in the axils of foliage leaves, the very short rachis (up to c. 16 mm long) with condensed internodes and bracts, glabrous; bracts ovate or triangular, c. 1 mm long, glabrous. Pedicel and ovary c. 18 mm, glabrous. *Perianth* green and dark purple, veins longitudinal and reticulate, glabrous outside; utricle subglobose, c. 7 mm  $\phi$ , with a distinct stipe of 3–5 mm, sparsely hairy inside, with 2 glandular, orbicular bodies (c. 1 mm  $\phi$ ); tube straight or sometimes bent at anthesis almost at a right angle with the utricle and ovary, c. 13 by 2.5 mm, sparsely hairy inside; limb 1-lipped, obovate-oblong, 23–30 by 10 mm, longitudinally reflexed at anthesis, apex retuse, upper surface glabrous except the slightly hairy margin. *Stamens* 6; anthers oblong, c. 1 mm long. *Style* column c. 4 mm long, 6-lobed; lobes lanceolate, c. 1.5 mm long, with a distinct annular ring at the base. *Capsules* short-cylindric, 2–3 by 1.5–2 cm, slightly 6-ridged, glabrous. *Seeds* triangular, winged, 4–5 by 4 mm (incl. the c. 0.6 mm wide wing), densely verrucose on both surfaces, upper surfaces sometimes covered with a membranous funicle appendage.

**Distr.** S. Ryukyu Is., Taiwan; in *Malesia*: Philippines (Luzon, Mindoro, Cebu, Bohol, Salupiri I.), NE. Sumatra (Pematang Siantar) and SE. Java (Besuki Res.: Puger).

**Ecol.** In forest or along forest edges, sometimes in rocky situations and on limestone hills, up to c. 300 m. *Fl.* April, Aug., Oct., Nov., fr. Feb.–June.

**Vern.** Philippines: *ubi-ubihan*, Tag.

**Notes.** The leaves of this species are very variable in shape, size, texture, etc. The leaf base can be shallowly cordate (with two divergent lobes), or sagittate (with a deep sinus and two  $\pm$  parallel lobes). The leaves on the specimens collected from Sumatra and Java are ovate-oblong and sagittate at the base, but those from the southern Ryukyus and Taiwan are often deltoid, ovate, or suborbicular, and shallowly cordate at the base. However, there are intermediate forms among the specimens from the Philippines: sometimes various leaf forms are even found in one specimen.

The polymorphism of the leaves in the present species can be compared with that found in the well known Japanese *A. kaempferi* WILLD.

Some of the leaf forms are similar to those of *A. foveolata*, in shape and indumentum underneath, but that species is quite different in flowers and seed.

*A. zollingeriana* closely resembles *A. tagala*, but can easily be distinguished: in the first the undersurface of the leaves is minutely hairy and with distinct areolation, in the latter it is sparsely short-hairy, rarely glabrous and with obscure areolation. In flower, fruit and seed the two are different.

The leaves of *A. zollingeriana* resemble those of the Japanese *A. kaempferi* WILLD.; the undersurface



of the leaves in the first is rather densely minute-hairy, in the latter there are loosely appressed hairs. Fertile specimens of *A. kaempferi* differ by absence of a stipe-like part of the perianth base, perianth curved in the middle, more or less V-shaped, limb suborbicular in outline, obscurely 2-lobed, and seed concave-convex, not winged.

**6. *Aristolochia minutiflora*** RIDLEY ex GAMBLE, Kew Bull. (1910) 79, incl. var. *dolabrata* GAMBLE; KING & GAMBLE, J. As. Soc. Beng. 75, ii (1912) 31; RIDLEY, Fl. Mal. Pen. 3 (1924) 18.

Scandent shrub or climber, up to 10 m high. Branches 3–10 mm  $\phi$ , sulcate, twisted, glabrous. Leaves thin-chartaceous, lanceolate sometimes ovate in outline, (5.5–) 12–14 by (2.5–) 5.5–7 cm; apex acuminate or cuspidate; base cordate, sinus 7–20 mm deep, 12–20 mm wide, auricles rounded at the base; glabrous above, loosely puberulous beneath; basal nerves 2 (–3) pairs, palmate, slightly elevated below, distinct above, inner pair of nerves ascending obliquely and slightly curved inward, up to c. 2/3 of the blade; veins usually loosely reticulate, some transverse, rather fine, distinct beneath, faint above; petiole 2–6.5 cm, glabrous. *Inflorescences* in the axils of foliage leaves, spiciform, up to c. 3.5 cm long, internodes very short or obscure, sparsely puberulous or almost glabrous; bracts lanceolate, 2–4 mm long, shortly hairy on both surfaces. Pedicel and ovary 9–12 mm, sparsely minutely hairy. *Perianth* green, red and light grey, straight, sparsely shortly hairy outside, glabrescent or almost glabrous; utricle broad-ovoid or subglobose, 3–6 by 2.5–6 mm, not stiped, sparsely hairy inside, with 2 ellipsoid, glandular bodies; tube 2.5–5 by 1 mm, short-fimbriate inside; limb 1-lipped, narrow-lanceolate to linear, 11–12 by 2–3 mm, veins loosely reticulate, rather faint, glandular hairs usually at the lower half of the upper surface. *Style* column c. 1 mm long, obscurely 6-lobed, with a distinct, annular ring. *Stamens* 6; anthers oblong, c. 0.3 mm long. *Capsules* oblong-obovoid, 1.7–2.5 by c. 1.2 cm, 6-ridged, distinctly transversely rugose outside (marked by the seeds). *Seeds* ovate, c. 5 by 4 mm, not winged, granulate on both surfaces.

*Distr. Malesia:* Malay Peninsula (Dindings, Perak, Johore), Borneo (Sarawak: Kelabit Highlands; Sabah: Mt Kinabalu, Sandakan; NE. Kalimantan: Mt Buduk Rakik).

*Ecol.* In primary forest, sometimes found in swampy forest, or old secondary forest, from lowland up to 1300 m. *Fl.* March–Aug., *fr.* Aug., Sept.

**7. *Aristolochia glaucifolia*** RIDLEY, Kew Bull. (1925) 88; DING HOU, Blumea 29 (1983) 228, f. 2d.

Twiner up to c. 8 m high. Branches terete, 1.5–3 mm  $\phi$ . Leaves thin-chartaceous, ovate (in outline),

5–13 by 4–6 cm; apex acuminate; base cordate, auricles almost oblong, 1.5–3 by 1–2 cm, rounded, the sinus 1.5–3.5 cm deep, glabrous above, lower surface sparsely shortly hairy, sometimes glaucous; basal nerves 1 pair, ascending upward to the apex, each with 1–3 branches along the inner margin of the auricles, slightly elevated beneath, faint above; veins loosely transverse or reticulate, distinct beneath, obscure or invisible above; petiole subterete, 3–7 cm, glabrous. *Inflorescences* in the axils of foliage leaves, rarely cauligerous, spiciform, up to 2 cm long, slightly short-hairy; bracts ovate, 2–10 (–20) mm long, sparsely puberulous on both surfaces. Pedicels and ovary 6–13 mm long, sparsely puberulous, glabrescent. *Perianth* pale yellowish green and somewhat purplish at the base, brownish, or dark brown, straight, with loosely reticulate veins, glabrous outside; utricle broad-ellipsoid, 10–12 by c. 5 mm, sparsely, shortly hairy inside, with 2 glandular, elliptic bodies (1.5–2 mm long); tube cylindric, 5–11 by 1–2.5 mm, sparsely hairy inside; limb 1-lipped, narrow lanceolate, 15–25 by 3–6 mm, shortly hairy on the upper surface. *Stamens* 6; anthers oblong, c. 0.6 mm long. *Style* column c. 1.5 mm long; lobes 6, triangular, c. 0.5 mm long, with a continuous, annular ring at their base. *Capsules* ellipsoid, 2.5–3 by 1.5 cm, slightly 6-ridged. *Seeds* triangular, 4 by 3.5 mm, not winged, granular on both surfaces, central part of the upper surface with a longitudinal ridge.

*Distr. Malesia:* Sumatra (northern part: Atjeh, Mt Sinabung, Kalandjaja, Petani Valley, Sibolangit, Singgalang; central western part: Batu I., Mt Kerintji, Pajakumbuh; southern part: Bencoolen).

*Ecol.* In primary forest, sometimes in old secondary forest, 500–1550 m. *Fl.* Feb.–Dec., *fr.* March, May, Sept.

*Note.* The plants of this species are easy to recognize by the rather thin-chartaceous, cordate-sagittate leaves glaucous underneath. According to BROOKS they are the food plant of *Papilio helenae* CUM.

**8. *Aristolochia klossii*** RIDLEY, Kew Bull. (1926) 78; DING HOU, Blumea 29 (1983) 231.

Scandent shrub. Branches c. 6 mm  $\phi$ , twisted, sulcate, glabrous. Leaves chartaceous, broad-ovate or deltoid in outline, 13.5–15 by 11.5–15 cm; apex obtuse or acute; base cordate or shallowly cordate, lobes rounded, the sinus 2–2.5 cm deep, 7–9 cm at the widest part; glabrous on both surfaces; basal nerves 1 pair, curved, ascending to the apex, each basal nerve branched quite near the base, thus almost forming another basal pair, elevated and prominent below, distinct sometimes slightly depressed above; veins loosely reticulate or transverse, slightly elevated below, faint above; petiole 4.5–6.5 cm, glabrous. *Inflorescences* in the axils of foliage leaves, racemiform, up to 6 cm long, sparsely puberulous or almost

glabrous; bracts ovate, c. 4 mm long, densely shortly hairy on the margin. Pedicel and ovary 8–20 mm, glabrous. *Perianth* deep crimson, white at base, limb pinkish, edge crimson, straight, with distinct, longitudinal and reticulate veins, glabrous outside, utricle ellipsoid, 10–15 by 5–8 mm, with a stipe of 3 mm, sparsely hairy inside, glandular bodies 2, ellipsoid, c. 2 mm long; tube 16–19 mm long, with scattered, glandular hairs inside; limb 1-lipped, obovate-oblong 20–25 by 10–14 mm, apex slightly retuse or mucronate, with scattered, glandular hairs on the upper surface. *Stamens* 6; anthers ellipsoid or oblong, c. 0.7 mm long. *Style* column c. 4.5 mm long, 6-lobed; lobes with basal parts united, projecting and forming an annular ring. Capsules unknown.

*Distr. Malesia:* Sumatra (Mentawai Is.: Sipora; Bandarbaru). Twice collected.

*Ecol. Fl. Oct.*

*Notes.* The leaves resemble those of *A. gaudichaudii* from the Moluccas and New Guinea.

More material and especially fruits are desirable.

9. *Aristolochia tagala* CHAMISSE, Linnaea 7 (1832) 207, t. 5, f. 3; KLOTZSCH, Monatsb. Akad. Berl. (1859) 597; DUCHARTRE in DC. Prod. 15, 1 (1864) 480; F.-VILL. Nov. App. (1880) 174; VIDAL, Phan. Cuming. (1885) 138; Rev. Pl. Vasc. Filip. (1886) 218; SOLEREDER, Bot. Jahrb. 10 (1889) 464; FORB. & HEMSL. J. Linn. Soc. Bot. 26 (1891) 363; KOORD. Minah. (1898) 567; MERR. Publ. Govt. Lab. Philip. 27 (1905) 72; KING & GAMBLE, J. As. Soc. Beng. 75, ii (1912) 30; MERR. Fl. Manila (1912) 186; Int. Rumph. (1917) 209; Sp. Blanc. (1918) 135; BACK. Trop. Natuur 8 (1919) 151, f. 7–12, 166; BROWN, Bull. Bur. For. Philip. (1921) 183; C.T. WHITE, Proc. R. Soc. Queensl. 34 (1922) 30; MERR. En. Philip. 2 (1923) 120; RIDLEY, Fl. Mal. Pen. 3 (1924) 18, excl. f. 136 (= *A. indica*); GAMBLE, Fl. Pres. Madras pt 7 (1925) 1202; MOORE, J. Bot. 63 (1925) Suppl. 83; HEYNE, Nutt. Pl. (1927) 597; KOIDZUMI, Fl. Symb. Orient.-Asiat. (1930) 16; MERR. Gard. Bull. S. S. 8 (1935) 131; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; BURK. Dict. 1 (1935) 239; MERR. Comm. Lour. (1935) 142; KANJILAL c.s. Fl. Assam 4 (1940) 28; HOEHNE, Fl. Brasil. Fasc. 6 (vol. 15, 2) (1942) 136, t. 120; MERR. & PERRY, J. Arn. Arb. 23 (1942) 384; *ibid.* 29 (1948) 153; QUIS. Medic. Pl. Philip. (1951) 255; HEND. Mal. Wild Fl. (1951) 421, f. 381A & B; L.S. SMITH, Proc. R. Soc. Queensl. 68 (1957) 45; LIANG, Acta Phytotax. Sin. 13 (1975) 17, f. 1, 5; BACK. & BAKH. f. Fl. Java 1 (1963) 163; KAO, Fl. Hainan 1 (1964) 327, f. 163; H. KENG, Mal. Seed Pl. (1969) f. 58; *ibid.* ed. 2 (1978) f. 59; LIANG, Acta Phytotax. Sin. 13 (1975) 17, f. 1, 5; LIU & LAI, Fl. Taiwan 2 (1976) 576; ANONYMOUS, Icon. Cormophyt. Sin. 1 (1972) 548, f. 1096; IGARASHI, Food Pl. Papilionidae (1979) t. 12; PERRY, Medic. Pl. E. & SE. Asia (1980) 47; DING HOU, Blumea 29 (1983) 232. — *Peponaster major* RUMPH. Herb. Amb. 5 (1747) 474. — *A. acuminata* LAMK. Encycl. 1 (1783) 254; WILLD. Sp. Pl. 4 (1805) 157; SPRENG. Syst. Veg. 3 (1826) 751; BL. En. Pl. Jav. 1 (1827) 81; ROXB. Fl. Ind. ed. Carey 3 (1832) 489; WIGHT, Icon. Pl. Ind. Or. (1844) t. 771; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1066; DALZELL & GIBSON, Bombay Fl. (1861) 224. — *A. longifolia* ROXB. [Hort. Beng. (1814) '102']; Fl. Ind. ed. Carey 3 (1832) 490. — *A. timorensis* DECNE, Ann. Mus. Hist. Nat. Paris III, 3 (1834) 368; Herb. Timor. Descr. (1835) 40; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1066; KLOTZSCH, Monatsb. Akad. Berl. (1859) 597; DUCHARTRE in DC. Prod. 15, 1 (1864) 481; BRITTEN in Forbes, Wand. (1885) 515; ENGL. Bot. Jahrb. 7 (1886) 453; LAUT. Bot. Jahrb. 52 (1914) 105. — *A. indica* (non L.) BLANCO, Fl. Filip. (1837) 282; ed. 2 (1845) 197; ed. 3, 1 (1877) 349; F.-VILL. Nov. App. (1880) 174. — *A. roxburghiana* KLOTZSCH, Monatsb. Akad. Berl. (1859) 596, excl. WALLICH n. 2704 (= *A. indica*); F.-VILL. Nov. App. (1880) 174; DUCHARTRE in DC. Prod. 15, 1 (1864) 480, incl.  $\beta$  *angustifolia* DUCHARTRE; HOOK. f. Fl. Br. India 5 (1886) 75; SOLEREDER, Bot. Jahrb. 10 (1889) 460; LAUT. Bot. Jahrb. 52 (1914) 106; BOLDINGH, Zakfl. Landb. Java (1916) 37; KOORD. Exk. Fl. Java 4 (Atlas) (1926) 590, f. 872; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241. — *A. moluccana* DUCHARTRE in DC. Prod. 15, 1 (1864) 438, nom. *superfl.*, new name for *A. longifolia* ROXB. (1832). — *A. japonica* MIQ. Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 136; Prol. Fl. Jap. (1866) 68. — *A. megalophylla* K. SCH. in K. Sch. & Hollr. Fl. Kais. Wilh. Land (1889) 104; WARB. Bot. Jahrb. 13 (1891) 300; K. SCH. Notizbl. Berl.-Dahl. 2 (1898) 113; K. SCH. & LAUT. Fl. Deut. Schutzgeb. Südsee (1900) 302; RECHINGER, K. Ak. Wiss. M.-N. Kl. Wien 89 (1913) 549; LAUT. Bot. Jahrb. 52 (1914) 106; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; PEECKEL, Illustr. Fl. Bismarck Arch. (MS) 4 (1947) *sub* f. 528. — *A. mindanaensis* WARB. in Perkins, Fragm. Fl. Philip. (1905) 169; MERR. En. Philip. 2 (1923) 119. — **Fig. 1f.**

Twinner, up to 20 m high. Branches terete, slightly furrowed, 3–5 mm  $\phi$ , glabrous. *Leaves* variable in shape and size, ovate, ovate-oblong, rarely subsorbicular, 6–20 (–27) by 4–10 (–16) cm; apex acute or acuminate; base cordate, auricles rounded, often connivent, the sinus up to 3.5 cm deep; glabrous or nearly so above, sparsely shortly hairy, or subglabrous beneath; basal nerves 2 pairs, the inner one ascending upward to more than 2/3 of the blade, similar in appearance to the lateral nerves, the outer one much shorter and weaker, often branched; lateral nerves 3–5 pairs, elevated below, slightly elevated or faint above; veins loosely reticulate or crossbar-like, distinct below, obscure above; petiole 2–6 cm,

slightly hairy. *Inflorescences* in the axils of foliage leaves, racemiform or paniculate, 2–6 cm long, slightly hairy, glabrescent, or glabrous; bracts ovate to lanceolate, up to 10 mm long, puberulous on both surfaces. Pedicel and ovary 10–18 mm long, sparsely hairy, glabrescent. *Perianth* pale yellowish with purple throat, pale or sordidly green with purple, purplish, or dark reddish brown, straight or slightly curved, venation faint, sparsely hairy, glabrescent outside; utricle broad-ovoid or subglobose, 3–9 by 3–7 mm, with a stipe of 1–3 mm, hairy inside, with 2 glandular, ovoid bodies (c. 0.7 mm long); tube 5–10 (–15) by c. 2.5 mm, hairy inside; limb 1-lipped, lanceolate to narrow-lanceolate, 20–30 (–40) by 6–8 mm, apex acute, hairy on the upper surface. *Style* column c. 3 mm long, 6-lobed; lobes conical, c. 1.5 mm long, at base forming an annular ring. *Stamens* 6; anthers oblong, c. 1 mm long. *Capsules* subglobose, slightly pyriform, or oblong, 3–4 by 2–3 cm, often 6-ridged, glabrous. *Seeds* triangular, winged, 8.5–10 mm long and wide (incl. the c. 2 mm wide wing), granular beneath, much less so above; funicle with membranous extension covering the upper surface (dry state).

*Distr.* Widely distributed in India, Sikkim, Sri Lanka, Bangladesh, Burma, Thailand, Cambodia, Vietnam, China; *Malesia* (throughout), New Ireland, New Britain, Solomon Is., Australia (Queensland). Cultivated in Hort. Bog. *sub n.* XV-D-40 and XV-K-AXI-9.

*Ecol.* In forests and thickets, often at low and medium altitudes (0–800 m), sometimes up to c. 1350 m (e.g. New Guinea). *Fl. fr.* all the year round.

*Uses.* The powdered roots are said to be tonic, carminative, and emmenagogic, and a very efficient remedy for infantile tympanites if they are pulverized and applied to the abdomen (QUISUMBING, *l.c.*).

In Ambon, the leaves, ground with curcuma and warmed, are smeared on the abdomen and the limbs when they are swollen; or they are made into a paste for use against such a skin disease as formication (HEYNE, *l.c.*; BURKILL, *l.c.*).

*Vern.* Sumatra: *běngkuh-běngkuh*, *kěping-kěping*, *olor fěngkuh-kěping*, Simalur. Malay Peninsula: *akar ara bukit*, *akar kětola huta*, *akar pětola hutan*, M. Java: *kalajar* or *kalaijar*, S; *kapassan*, *prodjon*, *pujan*, J. Timor: *wunbewa*. Bunguran Is. (= Groot Natoena): *mili utan*, M. Philippines (MERRILL, 1923, *l.c.*): *altán*, *malaubi*, *parolparulan*, *tala-talarum*, *timbangán*, *timbang-timbangán*, Tag., *goan-goan*, Bis., *kamkamaulau*, Ig., *nagerús*, *taoin-táoin*, Ilk. Celebes: *kunit*, Manado. Moluccas: *ja-wepplèwè*, Weda, *sasa baru*, Ternate. New Guinea: *kobi*, Garaina, *kolura*, Bangwe, *mangkapdupdak*, Biak, *sisidi*, Merauke.

**10. *Aristolochia coadunata* BACK.** *Trop. Natuur* 8

(1919) 154, f. 13, 167; Bull. Jard. Bot. Btżg III, 2 (1920) 320; BACK. & BAKH. *f. Fl. Java* 1 (1963) 164; STEEN. Mountain Fl. Java (1972) *sub t.* 4, 1; DING HOU, *Blumea* 29 (1983) 227. — **Fig. 12.**

**a. var. *coadunata*.**

Scandent, high liana, 10–50 m long. Branches subterete or slightly flattened, 0.5–1.2 cm ø, young parts densely pubescent, glabrescent. *Leaves* subcoriaceous, ovate-oblong to lanceolate, rarely ovate, 7.5–33 by 4–12 cm; apex acuminate, short-acuminate, or acute; base slightly cordate, basal lobes rounded (and the sinus 0.5–1 cm deep, sometimes obscure); upper surface pubescent especially on midrib and nerves, glabrescent; undersurface villous or densely tomentose, glabrescent; basal nerves one pair, reaching upward to 1/3–1/2 of the blade, lateral nerves 4–7 pairs, pinnate, veins rather closely reticulate; both nerves and veins elevated beneath, distinct or faint, sometimes depressed or bullate above; petiole 3–9 cm, pubescent. *Inflorescences* in axils of foliage leaves, rarely cauligerous, solitary or fasciculate, racemiform, up to 2 cm long, pubescent; bracts ovate, c. 1.5 mm long, densely pubescent or tomentose. Pedicel and ovary 4–8 mm, pilose. *Perianth* dark purple with yellow throat, geniculate, sigmoid, pubescent outside, venation obscure; utricle ovoid-tubular, 2.5–3 by 0.7 cm, the apical part bent backward, hairy at the lower half inside; tube cylindric, 3–4.5 by 0.6 cm, closely laterally in contact with the utricle, the basal part inside slightly projecting into the utricle cavity, almost glabrous inside; limb rim-like, 1.5–3 cm ø, the rim 0.5–1 cm wide, very obliquely positioned on the tube, obscurely 3-lobed. *Stamens* 6; filaments short; anthers oblong, 2–2.5 mm long. *Style* column 5–7 mm long; lobes 3, triangular, c. 1 mm long. Fruit unknown.

*Distr.* *Malesia*: Sumatra (Berastagi; Mt Kerintji), West to East Java (Priangan: Mts Malabar & Pandajana; Mt Lawu, above Pudjon, probably Mt Kawi, SE. Mt Smeru, G. Pendil on Mt Idjen).

*Ecol.* In primary, occasionally in secondary, mountain forest, 1000–2100 m. *Fl.* April, June, Oct., Nov.

*Taxon.* Closely allied to the Himalayan *A. saccata* WALL. from which it differs by the smaller, non-saccate flowers which have the perianth tube in close contact with the utricle.

**b. var. *bosschai* BACK.** *Trop. Natuur* 8 (1919) 154, 168; Bull. Jard. Bot. Btżg III, 2 (1920) 321; BACK. & BAKH. *f. Fl. Java* 1 (1963) 164.

Similar to var. *coadunata*, except the perianth limb entirely sulphureous.

*Distr.* *Malesia*: West Java (Preanger: Talun). Only known from the type.

*Ecol.* In primary forest, 1600 m





Fig. 12. *Aristolochia coadunata* BACK. After a coloured drawing made for VAN STEENIS, Mountain Flora of Java,  $\times 2/3$ . West Java, Mt Papandajan, Tegal Pandjang, July 1940 (VAN STEENIS 12625).

**11. *Aristolochia momandul*** K. SCH. in K. Sch. & Holtr. Fl. Kais. Wilh. Land (1889) 105; K. Sch. & LAUT. Fl. Deut. Schutzgeb. Südsee (1900) 302; LAUT. Bot. Jahrb. 52 (1914) 106; DING HOU, Blumea 29 (1983) 239, f. 5a, 6b, 7c. — *A. pithecurus* RIDLEY, J. Bot. 52 (1914) 296; MOORE, J. Bot. 61 (1923) Suppl. 40; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; IGARASHI, Food Pl. Papilionidae (1979) t. 24. — *A. gracilifolia* SCHMIDT, Bot. Jahrb. 58 (1923) 490; MERR. & PERRY, J. Arn. Arb. 23 (1942) 383. — *A. dictyophlebia* MERR. & PERRY, J. Arn. Arb. 29 (1948) 152. — **Fig. 8b.**

Twiner up to 6 m, sometimes scrambling on (tall) tree top up to 30 m. Old stem terete, 2.2–4 cm  $\phi$ ; branches terete, c. 4 mm  $\phi$ , short-hairy, glabrescent. Leaves chartaceous to coriaceous, lanceolate, elliptic, or ovate, (7–) 10–25 (–43) by (2–) 3–11 (–21) cm; apex acuminate, short-acuminate, rarely cuspidate; base subcordate, deeply cordate (especially plants from rather lower altitude), or slightly concave, rarely rounded or subtruncate (especially when young, or in plants from rather higher altitude); sinus 0–1 (–5) cm; subglabrous or glabrous above, shortly hairy especially on the midrib, nerves and veins; nerves elevated and prominent beneath, less so above; basal nerves 1 pair, ascending upwards to c. 1/2–2/3 of the blade, branched at base; lateral nerves 3–5 pairs; veins reticulate or crossbar-like, prominent beneath, distinct or sometimes faint above; petiole (1–) 2–3.5 (–7) cm, densely hairy. Inflorescences in axils of leaves, or cauligerous, paniculiform, rachis 4–19 (or more) cm long, with spacious internodes, densely hairy; bracts minute, densely hairy. Pedicel and ovary c. 20 mm long, densely hairy. Perianth straight or with slightly curved tube, white or pale green with purple venation, dull wine purple with yellow or orange yellow, longitudinal veins distinct, reticulations rather faint, densely hairy outside, with scattered hairs inside; with a contraction between perianth and ovary, no stipe; utricle obovoid, c. 10 by 7 mm; tube gradually enlarged toward apical part, c. 12 by 10 mm; limb an obovoid body with a long filiform tail composed of the ends of the lobes; limb 3-lobed (very rarely with an additional filiform fourth lobe); lobes suborbicular, c. 10 mm  $\phi$ , with an apical tail-like appendage (easily broken off) c. 20 mm. Stamens 6; anthers oblong, 1.2–1.7 mm long. Gynostemium c. 3.5 mm long; style 6-lobed; lobes triangular, 1.5–2 mm long, each lobe with the basal part slightly extended outward or downward. Capsules golden yellow or brilliant orange when ripe, oblong or ellipsoid, 5.5–9 by 3.5–4 cm, strongly 6-ridged, smooth (fine-granular under a hand lens); mostly found indehiscent, but obviously finally dehiscent. Seeds triangular or deltoid, 9–10 mm long and wide, smooth on both surfaces, not winged.

Distr. *Malesia*: Moluccas (Halmahera), West New Guinea (Sorong, Oransbari, Andai, Jappen, Biak); Papua New Guinea (Sepik, Madang, Morobe, Central Distr.), New Britain.

Ecol. In primary forest, beach forest, sometimes occurring in limestone areas on rocky peak; at low and medium altitudes, sometimes found up to 1650 m. Fl. Jan.–July, fr. Jan.–June, Sept., Oct.

Uses. Sap from the vine said to be used in 'papeda' (sago-porridge) (VINK BW 17561, L).

Vern. West New Guinea: *ba*, Oransbari lang.; Papua New Guinea: *momandul*, Madang.

Notes. The leaves of the present species are very variable, in shape, size, texture, and base, but flowers and fruit are uniform, the tailed buds and lobes being very characteristic.

As already pointed out by SCHUMANN it is related to *A. deltantha* F. v. M. from Queensland, from which it can be distinguished by the tail-like apex of the perianth lobes; in *A. deltantha* the perianth is hardly lobed. The leaf variability is in both the same.

*A. momandul* was described on fruiting material. In 1914 LAUTERBACH associated flowering material with it (FORBES 621, the type of *A. pithecurus* RIDLEY). Because the species cannot be distinguished from *A. schlechteri* on vegetative characters, it will be essential to have fruit of the latter, to check whether LAUTERBACH's conclusion was correct. LAUTERBACH erroneously described his material to have 6 perianth lobes.

**12. *Aristolochia rumphii*** KOSTELETSKY, Allg. Med.-Pharm. Fl. 2 (1883) 465; MERR. Int. Rumph. (1917) 209; HEYNE, Nutt. Pl. (1927) 596; DE WIT, Rumph. Mem. Vol. (1959) 348; PERRY, Medic. Pl. E. & SE. Asia (1980) 47; DING HOU, Blumea 29 (1983) 232, f. 2b. — *Radix puluronica* RUMPH. Herb. Amb. 5 (1747) 476, t. 177. — *A. indica* (non L. 1753) L. in Stickman, Herb. Amb. (1754) 25, *quoad Radix puluronica* RUMPH.; FILET, Bot. Tuin Weltev. (1855) 50; BISCHOP GREVELINK, Pl. Ned. Ind. (1883) 268. — **Fig. 15c.**

Climber. Branches c. 2 mm  $\phi$ , smooth, glabrous. Leaves thin-chartaceous, oblong, elliptic-oblong, ovate-oblong, narrow-lanceolate, 7–12.5 by (1–) 3–5.5 cm; apex acuminate; base obtuse, sometimes slightly cuneate, rarely truncate; glabrous, minutely shortly hairy beneath, glabrescent; 1 pair of basal nerves, ascending upward to about halfway the blade, lateral nerves 4 or 5 pairs distinct sometimes faint beneath, rather faint above; veins loosely transverse or reticulate, often faint beneath, obscure above; petiole 1.5–2.5 cm, glabrous or sometimes sparsely short-hairy. Inflorescences in axils of foliage leaves, usually very short, sometimes up to c. 5 cm long, racemiform and with distinct internodes; bracts ovate, 1.5–2 mm long, hairy on the margin, glabrescent. Pedicel and

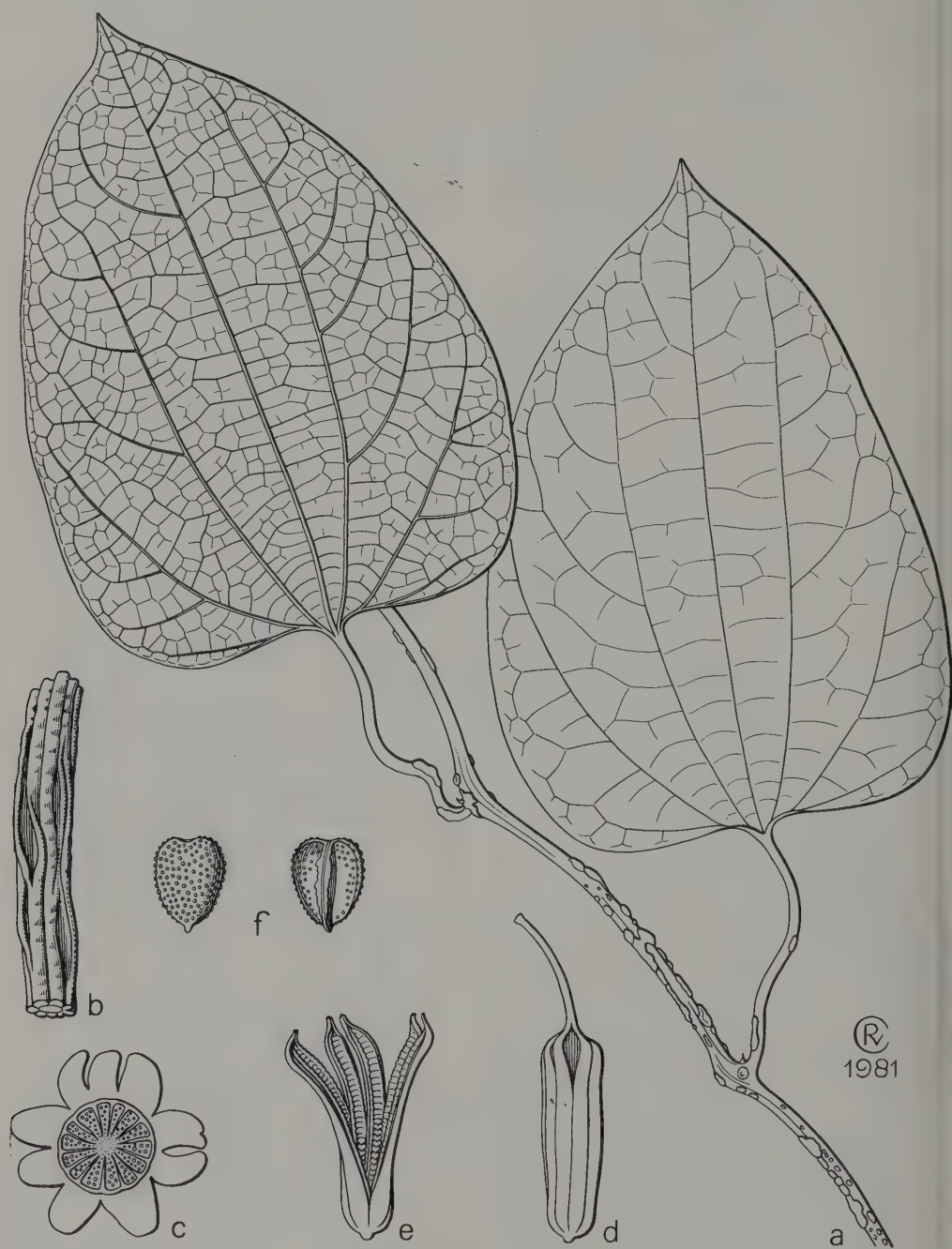


Fig. 13. *Aristolochia papillifolia* DING HOU. *a.* Habit, note lenticels, *b.* old stem with thick furrowed bark, both  $\times \frac{1}{2}$ , *c.* CS of *ditto*, note medullary rays and vascular bundles,  $\times 2$ , *d-e.* opening of fruit,  $\times \frac{1}{2}$ , *f.* immarginate seed, dorsal and ventral (*a-c* SAN 34658, *d-f* SAN 17334). Courtesy of Blumea.



ovary 10–30 mm, minutely hairy, glabrescent. *Perianth* green with brown limb, straight or with the limb slightly bent, minutely hairy outside; utricle subglobose, c. 6 mm  $\phi$ , with a distinct stipe of 5 mm, hairy inside, 2 glandular, subglobose bodies (c. 0.3 mm  $\phi$ ); tube 17 by 1.5 mm, sparsely hairy inside; limb oblong, 27 by 7 mm, hairy above, glabrescent, margin reflexed. *Style* column c. 2 mm long, 6-lobed; lobes lanceolate, c. 1 mm long, basal parts projecting and forming an annular ring. *Stamens* 6; anthers oblong, c. 0.7 mm long. *Capsules* short cylindric, c. 2.2 by 1.5 cm, 6-ridged. *Seeds* triangular, 5 by 5–5.5 mm, verrucose on both surfaces, not winged.

**Distr.** *Malesia*: SW. Celebes (Pangkajene), Kajuadi Is. (halfway Flores), Lesser Sunda Islands (Sumba, Flores, Timor), Moluccas (Ambon, not seen; Kai and Tenimber Is.).

**Ecol.** In light forest, grass field and thickets, up to c. 100 m. *Fl.* April–June, *fr.* March–July.

**Uses.** A decoction of a piece of the root or of small twigs (less powerful than root) is used to treat stomach-ache, spasm and constipation, and also intermittent fever. On trips travellers often take a piece of root or lowest part of a stem about the length of a finger and drink the decoction from it as tea (RUMPHIUS, l.c.; HEYNE, l.c.; PERRY, l.c.).

**Vern.** *Akar pulurun*, Ambon, *tuhe tutunu*, Banda, *warosbot*, Tenimber I.

**Notes.** One fertile specimen, collected on a hill above Endeh (Flores) by Father J.J. LOETERS (n. 2092, L) has one flower and one fruit which match those of the present species, though its leaves are very narrow, c. 1 cm wide (fig. 15e).

*A. rumphii* is closely allied to *A. indica* from Southeast Asia (mainly Ceylon and India), similar in leaf characters and a 1-lipped perianth with a distinct stipe-like base. It can be distinguished from *A. indica* by the few-flowered inflorescences with distinct internodes, a longer pedicel and ovary, up to 3 cm (in *A. indica* up to 1.5 cm), the longer stipe of the utricle, c. 5 mm (2.5 mm in *A. indica*), the rather long perianth tube up to 17 mm (against c. 8 mm), smaller capsules, c. 2–3 cm (against 4–5 cm), and immarginate seeds (distinctly winged in *A. indica*).

**13. *Aristolochia papillifolia*** DING HOU, Blumea 28 (1983) 346, f. 3, 5A–C. — **Fig. 13.**

Stout climber, up to 15 m high. Old stem terete, 1.5–2.5 cm  $\phi$ . Branches subterete or slightly flat, 5–7 mm  $\phi$ , glabrous. *Leaves* subcoriaceous, broad-ovate or ovate, 13–19 by 9–15.5 cm; apex acute or short-acuminate; base almost truncate, slightly concave, or rounded; glabrous above, glabrous but papillate in the areolae beneath; nerves palmate, basal nerves 2 pairs, each nerve with a few lateral, oblique branches, the inner pair of nerves reaching the apex, the outer pair much shorter; nerves elevated and

prominent beneath, distinct above; veins loosely transverse or reticulate, slightly elevated beneath, faint above; petiole stout, terete, glabrous, 6–12 cm. Bracts linear, 3.5–5 mm long, glabrous. Pedicel and ovary 3–4 cm, glabrous. *Flowers* cauligerous, fasciculate. *Perianth* straight, veins loosely reticulate, glabrous outside; utricle ellipsoid or subglobose, 6–7.5 by 5–6 mm, flanged at the base, hairy inside, with 6 ellipsoid or orbicular, glandular bodies (c. 1.5 mm long); tube 15–20 by 2 mm, hairy inside; limb 1-lipped, linear, 45–50 by 7–12 mm, papillate on the upper surface. *Stamens* 6; anthers oblong, c. 0.7 mm long. *Style* column 2 mm long, 6-lobed; lobes deltoid, c. 1 mm long, basal parts forming a distinct annular ring. *Capsules* cylindric, 6.5 by 1.2 cm, slightly 6-furrowed, obtuse on both ends. *Seeds* broad-ovate, c. 4 by 3 mm, granular on both surfaces, not winged.

**Distr.** *Malesia*: Borneo (Sabah: Sandakan, Tongod, Tawau Distr.; Sarawak: Gunung Buri).

**Ecol.** Ridge top in primary forest, hill slope in disturbed mixed dipterocarp forest, and also in secondary forest, up to c. 600 m. *Fl.* May, *fr.* June, July.

**Notes.** On the undersurface of the leaves the areolae are papillose, and cavities containing one stoma are surrounded by papillate cells (magnitude  $\times 40$ ); this is a unique character among the Malesian species.

The 1-lipped perianth has 6 glands inside the utricle, a character only known from *A. foveolata* and a West African species.

**14. *Aristolochia transtillifera*** DING HOU, Blumea 28 (1983) 348, f. 4, 5. — **Fig. 2a–b.**

Twinner. Branches terete, 3.5–6 mm  $\phi$ , slightly striate, glabrous. *Leaves* subcoriaceous, ovate-oblong, oblong-elliptic, rarely ovate, 16–20 by 6.5–10 cm; apex short-acuminate; base obtuse, sometimes slightly concave, or subtruncate, glabrous; basal nerves 2 pairs, the inner one ascending to the apex, elevated and prominent beneath, slightly depressed above, the outer pair shorter and much weaker, ascending close to or along the margin, slightly elevated beneath, obscure or invisible above; veins distinctly transverse, joined by closely reticulate veinlets, slightly elevated beneath, obscure or invisible above; petiole terete, 3–8 cm. *Flowers* unknown. *Infructescences* cauligerous, very short, condensed, bracteate, knobby; bracts lanceolate, 2–6 mm long, slightly puberulous on both surfaces, glabrescent. *Capsules* cylindric, 3–3.5 by 1.2 cm, obtuse at both ends, glabrous, smooth (but finely verrucose under a hand lens); pedicel c. 3.5 cm. *Seeds* triangular, 5 by 4–4.5 mm, subcordate at the base, not winged, finely verrucose on both surfaces, funicle with a thin expanded appendage covering the upper surface of the seed.

Distr. *Malesia*: Borneo (Sabah: Beaufort Distr.). Once collected.

Ecol. Hill side, primary forest, c. 30 m.

Notes. Though the species is as yet only known in fruit, it stands out by the glabrous, subcoriaceous leaves with obtuse to sometimes slightly concave base and clearly trabeculate venation with close reticulations.

It may be related to *A. foveolata* and *A. papillifolia*, but differs by these leaf characters.

**15. *Aristolochia naviculilimba* DING HOU, Blumea 28 (1983) 344, f. 2.**

Liana, up to 15 m high. Branches subterete, 3–6 mm  $\phi$ , glabrous. *Leaves* chartaceous, elliptic, 10–15 by 5.5–8 cm; apex shortly acuminate; base rounded or obtuse, rarely slightly concave; glabrous above, minutely hairy beneath especially on the venation; basal nerves 2 pairs, the inner pair and the midrib elevated, prominent beneath, distinct above, ascending obliquely and slightly curved nearly reaching the apex of the blade; outer pair of basal nerves rather weak, running along the margin; the longitudinal nerves joined by 10–14 loosely transverse or slightly curved nervules or stronger veins, slightly elevated beneath, distinct or faint above; veins and veinlets loosely reticulate, distinct or faint on both surfaces; petiole c. 3 cm, glabrous. *Flowers* (detached) cauligerous, on brachyblasts, internodes condensed, obscure; bracts lanceolate or lineate, 3–4.5 mm long, shortly hairy on both surfaces. Pedicel and ovary c. 3 cm long, glabrous. *Perianth* dull yellow with dark purple stripes and markings, curved, distinctly longitudinally 6-nerved or -veined, glabrous outside; utricle subglobose, 10–12 by 9–10 mm, abruptly contracted and collar-like at the base, densely hairy inside, with 2 ellipsoid, glandular bodies (3–4 mm long); tube often at right angles with the utricle, cylindric, c. 15 by 3 mm, glabrous inside; limb 1-lipped, ovate-oblong or lanceolate, naviculiform in side view when young, 60–90 by 30–35 mm, longitudinally incurved, inner surface almost glabrous, except sparsely short-hairy at the basal part. *Stamens* 6; anthers oblong, c. 1 mm long. *Style* column c. 3.5 mm long,

6-lobed, with an annular ring at the base; lobes triangular, c. 1.5 mm long. Capsules unknown.

Distr. *Malesia*: Borneo (Sarawak: Lundu Distr., Mt Poi; W. Kalimantan: Mt Kasian & Mt Liang Gang); 3 collections.

Ecol. In forest, c. 600 m. *Fl.* June, Oct.

Notes. The epithet alludes to the boat-shaped limb.

Superficially the leaves of this species resemble those of *A. transtillifera* in shape, but they are chartaceous, puberulous beneath, with 10–14 rather loose transverse cross-veins and reticulate veins.

**16. *Aristolochia decandra* DING HOU, Blumea 28 (1983) 343, f. 1. — Fig. 15a–d, 16.**

Liana. Old stem slightly flattened, 0.7–1.2 cm  $\phi$ , rather smooth, glabrous. Branches slightly flattened, 5–7 mm  $\phi$ , smooth, glabrous, often with a series of 3 or 4 buds in the leaf axil. *Leaves* firmly chartaceous, suborbicular or broad-ovate in outline, 13.5–22.5 by 11.5–18.5 cm; glabrous above, sparsely minutely hairy beneath; apex acuminate; base deeply cordate, sinus 3–4 cm deep, auricles with almost rounded ends, separate from each other, sometimes overlapping; glabrous above, sparsely minutely hairy underneath; basal nerves 2 pairs, the inner pair ascending to the apical part of the blade, the outer pair much shorter and giving off at its base a strong branch resembling a third basal nerve pair; midrib with 2–3 pairs of lateral nerves; nerves elevated, prominent beneath, distinct or sometimes rather faint above; veins loosely transverse and reticulate, slightly elevated beneath, faint or invisible above; petiole stout, subterete except the apical part, 10–13 cm long. *Inflorescences* in axils of fallen leaves or cauligerous, panicleiform, up to 15 cm long, puberulous; bracts ovate, c. 2.5 mm long, puberulous on both surfaces. Pedicel and ovary 4–5 cm, puberulous. *Perianth* bright yellow or yellowish green, straight except the apical part of the tube together with limb curved or bent, with longitudinal and loosely reticulate veins, puberulous outside; utricle broad-ellipsoid, 5–6.5 by 3.5–4 cm, flanged at the base, without a contracted stipe, with 2 glandular, ellipsoid bodies (c. 1.5 mm long); tube c. 5 by 1.5–2 cm, hairy inside, especially dense at the apical part, basal part projecting a band-like syrinx (c. 1.5 mm wide) into the cavity of utricle; limb 3-lobed, lobes linear, up to c. 9 by 1 cm, glandular hairy on the inner surface. *Stamens* 10; anthers oblong, c. 4 mm long. *Style* column 10 mm long, 10-lobed; lobes lanceolate, 2–3 mm long, usually hairy in the apical part. Capsules unknown.

Distr. *Malesia*: Kalimantan (Lower Serawai R.: Manga Landu & Lebang Hara, c. 112°30' E, 0°30' S). Two collections. Cultivated in Hort. Bog. *sub n.* XI-A-61, XI-D-32A & 40A, originated from the Bor-



Fig. 14. *Aristolochia naviculilimba* DING HOU. Lateral view of flower,  $\times 2/3$  (CLEMENS 20292).

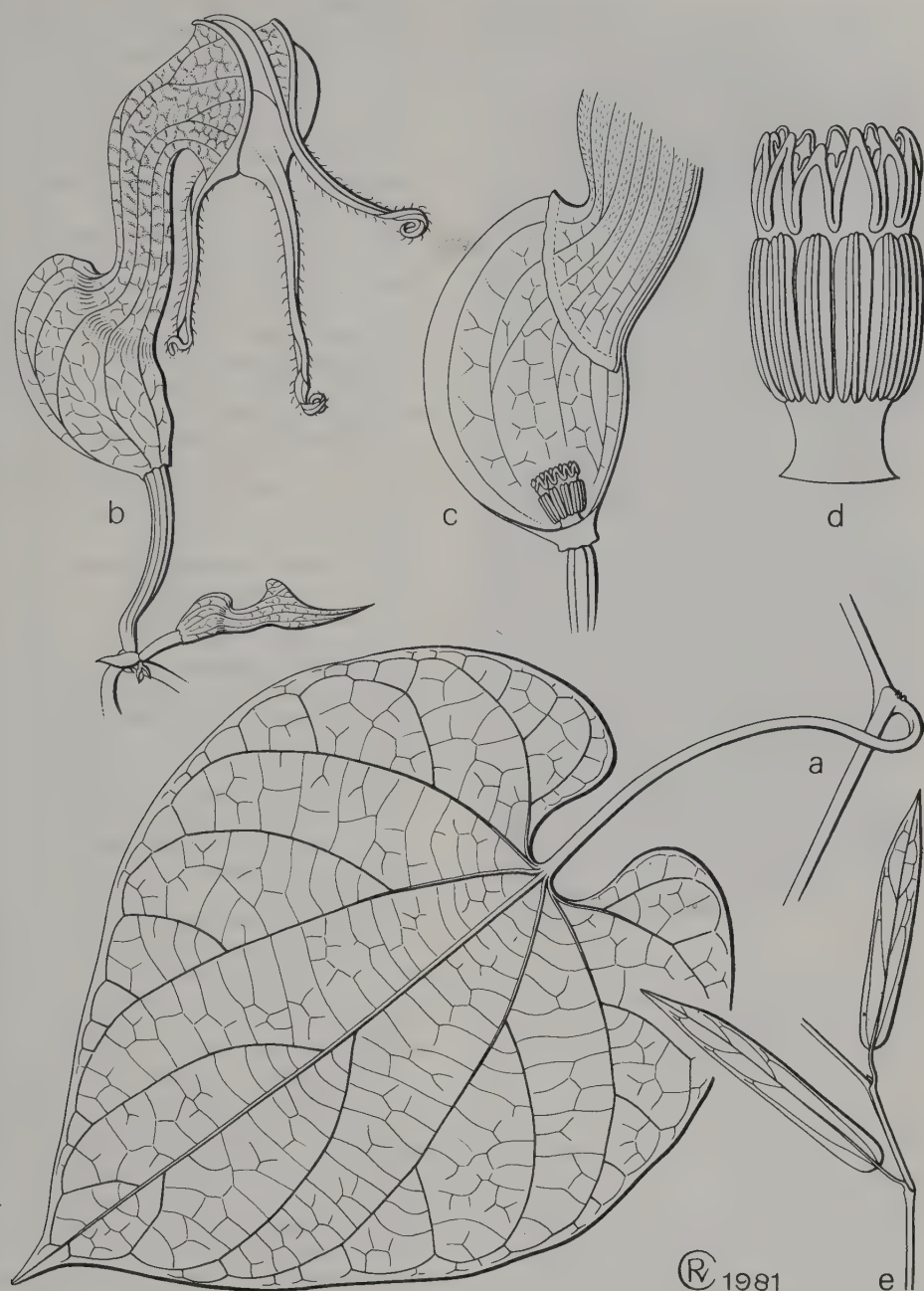


Fig. 15. *Aristolochia decandra* DING HOU. a. Leafy twig; b. young bud and open flower, both  $\times \frac{1}{2}$ ; c. LS of lower part of perianth showing the gynostemium inside the utricle and the base of the tube slightly elongating and projecting into the utricular cavity, nat. size, d. gynostemium,  $\times 5$ . — *A. rumphii* KOSTELETSKY. e. Leafy twig,  $\times \frac{1}{2}$  (a HANS WINKLER 1256, b after a drawing of a living specimen in Hort. Bog., Dec. 1945, in L, c-d HANS WINKLER 373, e LOETERS 2092). Courtesy of Blumea.



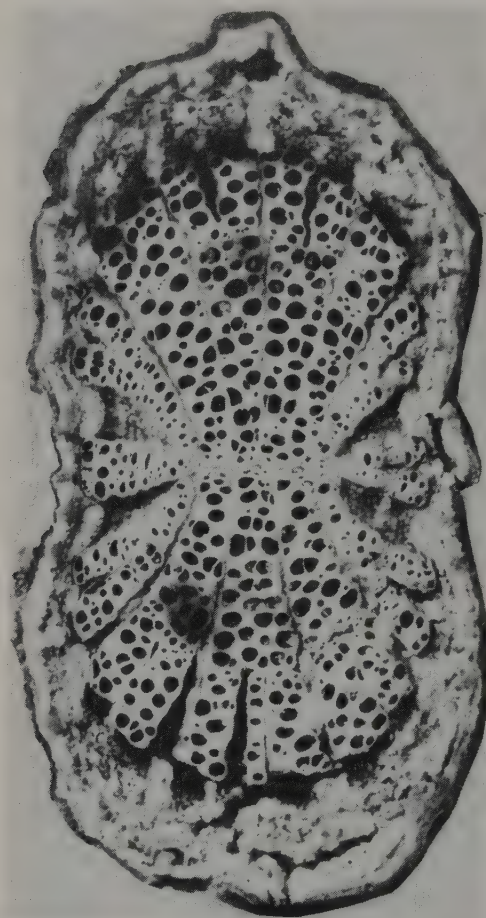


Fig. 16. *Aristolochia decandra* DING HOU. CS of flattened stem, medullary rays and wood sections with vascular bundles elongating in two directions,  $\times 5\frac{1}{2}$  (HANS WINKLER 1256).

near collection of P. DAKKUS.

Ecol. Primary forest, on river bank, 80–180 m. *Fl. Nov.*, Jan.

Vern. *Toro bakái*, Dajak.

Note. The only Malesian species with 10 stamens, the others always having 6. In flower it approaches the West African species of *Pararistolochia*. Unfortunately, it seems that the species is no longer extant in the Botanic Gardens at Bogor.

17. *Aristolochia samarensis* MERR. *Philip. J. Sc.* 11 (1916) Bot. 178; *En. Philip.* 2 (1923) 120; SCHMIDT in E. & P. *Nat. Pfl. Fam. ed. 2*, 16b (1935) 241.

Apparently erect plant c. 1 m high. Branches terete, striate, glabrous. *Leaves* thin-chartaceous, elliptic, 15–25 by 6–8.5 cm; apex acuminate, base cuneate; glabrous; basal nerves one pair, rather weak and short, ascending close to the margin up to  $\frac{1}{3}$ – $\frac{1}{2}$  of the blade; lateral nerves 6 pairs, slightly elevated beneath, rather faint above; veins loosely reticulate, some crossbar-like, distinct beneath, obscure or invisible above; petiole 6–10 mm, glabrous. *Inflorescences* in the axils of leaves, racemiform, rachis up to 1 cm long, with condensed internodes, puberulous; bracts ovate to lanceolate, 4–6 mm long, puberulous on both surfaces. Flowers not seen (characters based on MERRILL, *l.c.*). Pedicel and ovary 7 mm, glabrous. *Utricle* ellipsoid, c. 3.5 cm long; tube reflexed, 1–1.5 cm long; limb 1-lipped, narrowly oblong, 4.5 by 1 cm, apiculate-acuminate. *Stamens* 6; anthers ellipsoid, c. 1.5 mm long. *Style* column c. 6 mm long, 6-lobed; lobes narrowly oblong, c. 3 mm long. *Capsule* ovoid, c. 1.5 cm long, prominently ridged. *Seed* triangular, 4.5 by 3.5 mm, not winged, verrucose on both surfaces.

Distr. *Malesia*: Philippines (Samar: Catubig R. at Pinipisakan). Once collected.

Ecol. In damp forests near river at low altitude.

18. *Aristolochia philippinensis* WARB. in Perkins, *Fragm. Fl. Philip.* (1905) 170; MERR. *En. Philip.* 2 (1923) 119; SCHMIDT in E. & P. *Nat. Pfl. Fam. ed. 2*, 16b (1935) 241; QUIS. *Medic. Pl. Philip.* (1951) 254; IGARASHI, *Food Pl. Papilionidae* (1979) t. 16; PERRY, *Medic. Pl. E. & SE. Asia* (1980) 47. — Fig. 2c–d.

Erect shrubby plant up to c. 1 m high. Old stem terete, 4 cm  $\phi$ , slightly irregularly ridged. Branches terete, 5–10 mm  $\phi$ , slightly striate, sparsely puberulous, glabrescent, or glabrous. *Leaves* membranous or chartaceous, lanceolate, elliptic, or oblanceolate, 8.5–24 by 3.5–8.5 cm; apex acuminate or cuspidate; base obtuse, sometimes slightly cuneate; margin entire, rarely remotely minutely toothed; glabrous on both surfaces, sometimes sparsely short-hairy on the midrib, nerves and reticulations beneath; basal nerves 1 pair, faint, ascending close to the margin at the basal part of the blade; lateral nerves 5–8 pairs, slightly elevated on both surfaces; veins loosely reticulate, some crossbar-like, distinct sometimes faint on both surfaces; petiole 4–8 (–20) mm, glabrous. *Inflorescences* in axils of foliage leaves, spiciform or racemiform, rachis up to 2 (–6) cm long, with distinct internodes, sparsely shortly hairy or glabrous; bracts lanceolate, 2–4 mm long, shortly hairy on both surfaces, glabrescent. Pedicel and ovary 6–8 mm, sparsely hairy. *Perianth* straight, longitudinal and reticulate veins distinct, glabrous outside; utricle ovoid or ellipsoid, 6–7 by 5 mm, with a distinct stipe (3–4 mm) flanged at base; hairy inside, glandular bodies 2, obscurely orbicular, c. 0.7 mm  $\phi$ ; tube c. 15

by 2 mm, with scattered, glandular trichomes inside; limb 1-lipped, oblanceolate or narrow-oblanceolate, 18–25 by 3–6 mm, with scattered glandular trichomes, glabrescent. *Stamens* 6; anthers oblong, c. 1 mm long. *Style* column c. 4 mm long, 6-lobed; lobes triangular, 1–1.5 mm long, with an annular ring at the base. *Capsules* subglobose, shortly cylindric, or oblong-ellipsoid, 1.5–2.5 by 1.5 cm, glabrous. *Seeds* triangular or deltoid, 4–4.5 by 4 mm, not winged, verrucose beneath and marginal part above, funicle broadened and covering the upper surface.

Distr. *Malesia*: Philippines (Luzon, Mindoro, Bancalan I., Mindanao).

Ecol. In thickets and forest at low and medium altitudes, up to 900 m. *Fl.* March, June–Sept., *fr.* Jan., March–May, Aug., Sept., Nov., Dec.

Uses. Decoction of the roots is used in the Philippines as a stomachic and emmenagogue (QUISUMBING, l.c.).

Vern. *Barubó*, Neg., *ruso-pusoan*, Rizal, *tám-bal-balanding*, Zambales.

**19. *Aristolochia humilis* MERR.** Philip. J. Sc. 13 (1918) Bot. 9; En. Philip. 2 (1923) 119.

Low erect undershrub, up to c. 40 cm high. Stem terete, 5–10 mm  $\varnothing$ , with only 4–7 leaves, young parts sparsely puberulous, glabrescent. *Leaves* membranous to chartaceous, elliptic, rarely ovate, 8–25 by 5–11 cm; apex acute, slightly obtuse, or short-acuminate; base rounded or subacute; glabrous above, sparsely short hairy on the nerves beneath; and reticulations; 1 pair of basal nerves ascending close to the margin upward to c. 1/3 of the blade, much weaker than other nerves; lateral nerves 5–7 pairs, slightly elevated beneath, distinct sometimes faint above; veins loosely reticulate, some transverse, distinct beneath, rather faint above; petiole (2–) 3–4 cm, sparsely shortly hairy. *Inflorescences* in the axils of bracts and/or foliage leaves, rachis 2–3 cm long, with condensed internodes and bracts; bracts ovate, oblong, or lanceolate, 4–6 mm long, puberulous outside, glabrous inside. Pedicel and ovary 6–7 mm long, glabrous. *Perianth* straight, venation faint, glabrous outside, papillate inside; utricle oblong, ellipsoid or subglobose, c. 6 by 3–5 mm, with a distinct stipe (c. 2 mm) slightly flanged at base; tube 5–7 mm long; limb 1-lipped, oblanceolate, 18 by 4–6 mm. *Stamens* 6; anthers oblong, c. 0.7 mm long. *Style* column 1.5 mm long, 6-lobed; lobes triangular, c. 0.5 mm long, with an annular ring at the base. *Capsules* oblong-ellipsoid, 2–2.5 by 1.5 cm. *Seeds* triangular, convex-concave, c. 6 by 4.5 mm, verrucose on marginal part beneath, glabrous, covered above by the membranous appendage of the funicle, not winged.

Distr. *Malesia*: Philippines (Luzon: Tayabas). Twice collected.

Ecol. In damp forests along streams at low alti-

tude. *Fl. fr.* May.

Vern. *Tangotong-gúbat*, Tag.

**20. *Aristolochia macgregorii* MERR.** Philip. J. Sc. 5 (1910) Bot. 174; En. Philip. 2 (1923) 119. — **Fig. 1d.**

Erect shrubby plant up to 1 m high. Stems subterete, 3–5 mm  $\varnothing$ , striate, pubescent. *Leaves* chartaceous, lanceolate or slightly elliptic, 11–17 by 3–6.5 cm; apex acuminate, rarely acute; base cordate, sinus 0.5–1 cm deep, auricles often overlapping or surrounding the stem; shortly hairy on both surfaces, especially on midrib, nerves and veins; basal nerves often 2 pairs, inner pair ascending to halfway the blade, outer pair very short and weak; lateral nerves 2 or 3 (–6) pairs; nerves slightly raised or nearly flat on both surfaces; veins often reticulate, some crossbar-like, flat, distinct, rarely faint on both surfaces; petiole c. 3 mm, pubescent. *Inflorescences* in axils of foliage leaves, spiciform; rachis with condensed internodes up to 1.5 cm long, pubescent; bracts lanceolate, 3–6 mm long, pubescent on both surfaces. Pedicel and ovary c. 5 mm, pubescent. *Perianth* yellowish, erect, with rather faint reticulation, pubescent outside; utricle subglobose, c. 4 mm  $\varnothing$ , basal part contracted and stipe-like (0.7 mm long); tube cylindric, 10–16 by 2–2.5 mm; limb lanceolate, c. 20 by 3 mm, acuminate, pubescent on the inner surface. *Stamens* 6; anthers 1 mm long. *Style* column short, very obscurely lobed. *Capsules* oblong-ellipsoid, c. 1.5 by 1 cm, sparsely short-hairy. *Seeds* deltoid, c. 3 mm long and wide, not winged, verrucose on both surfaces.

Distr. *Malesia*: Philippines (Babuyan Is.: Dalupiri I. & Camiguin I.).

Ecol. In littoral thicket, up to 350 m. *Fl.* Aug., Nov., *fr.* Aug., Oct., Nov.

**21. *Aristolochia sericea* BLANCO.** Fl. Filip. (1837) 283; ed. 2 (1845) 198; ed. 3, 1 (1877) 350; MERR. Publ. Govt. Lab. Philip. 27 (1905) 72; Sp. Blanc. (1918) 134; BROWN, Bull. Bur. For. Philip. 22, 3 (1921) 183; MERR. En. Philip. 2 (1923) 120; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; QUIS. Medic. Pl. Philip. (1951) 255; PERRY, Medic. Pl. E. & SE. Asia (1980) 47. — *A. imbricata* MAST. J. Linn. Soc. Bot. 14 (1875) 494; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241. — *Bragantia corymbosa* (non GRIFF.) F.-VILL. Nov. App. (1880) 174. — *A. membranacea* MERR. Philip. J. Sc. 14 (1919) 381; En. Philip. 2 (1923) 119; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241.

Erect shrubby plant up to c. 0.5 m high. Stem terete, c. 3 mm  $\varnothing$ , densely pubescent, glabrescent. *Leaves* thin-chartaceous or membranous, lanceolate or oblong-lanceolate, 7–15 by 2–5 cm; apex acuminate; base slightly or shallowly cordate, sometimes the sinus up to 5 (–10) mm deep, rarely obtuse;

sparsely shortly hairy above, hairy especially dense on the venation beneath; basal nerves 2 pairs, inner pair reaching c. 1/3 of the blade, similar to the lateral nerves, outer pair weaker and very short, close to the margin; lateral nerves c. 5 pairs, rather faint beneath, faint or obscure above; petiole 2–5 mm, densely hairy. *Flowers* few (one developing at a time), on very short, bracteate rachides (less than 10 mm long) in axils of foliage leaves; bracts lanceolate or elliptic, 3–4 mm, rarely leafy up to 20 mm long, shortly hairy on both surfaces. Pedicel and ovary 4.5–5 mm, densely hairy. *Perianth* straight, sometimes slightly curved, reticulation rather distinct, hairy outside; utricle ovoid or ellipsoid, 2.5–5 by 2–2.5 mm, with a distinct stipe (1.5–2 mm) dilated at the base as a cap on top of the ovary, hairy inside, with 2 glandular, ellipsoid bodies (c. 0.6 mm long); tube 5–10 by 1 mm, with short, glandular hairs inside; limb 1-lipped, oblong, 11–15 by 3–4.5 mm, acute or acuminate. *Stamens* 6; anthers ellipsoid, c. 0.6 mm long. *Style* column c. 0.7 mm long, 6-lobed; lobes lanceolate, c. 1 mm, with an annular ring at the base. *Capsules* subglobose, c. 1 cm  $\phi$ , densely hairy, usually glabrescent. *Seeds* triangular, c. 2.5 by 1.5 mm, not winged, verrucose on both surfaces; funicle with membranous extension covering the upper surface.

*Distr. Malesia:* Philippines (Luzon: Cagayan, Ilocos Norte, Union, Batangas).

*Ecol.* In dry thickets at low and medium altitudes up to 350 m. *Fl.* Aug., Dec., *fr.* April, May, July, Aug., Dec.

*Uses.* The entire fresh plant is used as a carminative, emmenagogue and febrifuge. The root, macerated in local spirituous liquors, is administered postpartum as a uterine tonic; this drug is said to be a violent abortive (QUISUMBING, *l.c.*).

**22. *Aristolochia leytenensis* MERR.** Philip. J. Sc. 10 (1915) Bot. 4; En. Philip. 2 (1923) 119; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241.

Slender vine. Branches terete, sulcate, 2–6 mm  $\phi$ , glabrous. *Leaves* chartaceous or membranous, ovate or broad-ovate, 12.5–21.5 by 8–12.5 cm; apex acuminate; base cordate, sinus (1–) 2–3 cm deep, auricles separate from each other, sometimes overlapping at the base; glabrous on both surfaces, sometimes slightly puberulous on midrib, nerves and veins beneath when young, glabrescent; basal nerves 1 pair, ascending upward to 2/3–3/4 of the blade, forked at base; lateral nerves c. 3 pairs; nerves elevated and prominent beneath, distinct or flat above; veins loosely reticulate, some crossbar-like, distinct beneath, rather faint above; petiole (2–) 4–7 cm, glabrous. *Inflorescences* in the axils of foliage leaves, racemiform, rachis up to 3 cm long, with visible internodes, sparsely puberulous or glabrous; bracts ovate to lanceolate, 2–3 mm long, puberulous on

both surfaces especially on the margin. Pedicel and ovary 17–22 mm, puberulous. *Perianth* straight or slightly curved, with a distinct stipe (4–5.5 mm), venation visible, puberulous outside, hairy inside; utricle subglobose, 5–7 mm  $\phi$ , with 2 glandular, suborbicular bodies (c. 0.5 mm  $\phi$ ); tube c. 20 by 4 mm; limb 1-lipped, narrow-elliptic, 50–60 mm. *Stamens* 6; anthers oblong 0.6–1 mm long. *Style* column c. 4 mm long, 6-lobed; lobes triangular, c. 1 mm long, with an annular ring around the base. *Capsules* (young) subglobose or short-cylindric, c. 1.5 cm  $\phi$ .

*Distr. Malesia:* Philippines (Leyte, Samar).

*Ecol.* In thickets and forests near or along streams at low altitudes. *Fl.* Feb.–March, Aug., *fr.* Aug., Sept.

*Vern. Maraburakán*, S.L. Bis.

**23. *Aristolochia crassinervia* SCHMIDT**, Bot. Jahrb. 58 (1923) 491; in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; MERR. & PERRY, J. Arn. Arb. 29 (1948) 153; IGARASHI, Food Pl. Papilionidae (1979) t. 23; DING HOU, Blumea 29 (1983) 234, f. 4, 5b. — **Fig. 8c**, 17.



Fig. 17. *Aristolochia crassinervia* SCHMIDT, showing the common basket shape of the dehiscent, hanging capsule in the genus, with seven loose seeds, nat. size (HUTTON *s.n.*).



Liana, old stem up to c. 1.5 cm ø. Branches rather terete, 4–5 mm ø, with some prominent lenticels, glabrous. *Leaves* subcoriaceous, (5–) 8–19 by (4–) 5–12 cm; apex acuminate or short-acuminate; base cordate, with a narrow sinus up to 2.5–3 cm deep; auricles usually overlapping, rounded at apex; glabrous above, minutely hairy beneath; basal nerves 2 (–3) pairs, the inner pair similar to the midrib, ascending to near the apex of the blade, the outer one much shorter, with branches extending upward or to the auricles, elevated and prominent beneath, distinct above; lateral nerves hardly distinguishable from the veins; veins closely reticulate, elevated and prominent beneath, faint or invisible above; petiole (2–) 6–8 cm, sparsely shortly hairy or almost glabrous. *Inflorescences* cauligerous, rarely also in axils of leaves, racemiform, rachis up to 3 cm long, internodes very short or condensed, sometimes the bracteate flowering rachis very short and flowers appearing fascicled; bracts lanceolate, 5–10 mm long, sparsely minutely hairy on both surfaces, glabrescent. Pedicel and ovary c. 20 mm, glabrous. *Perianth* white or reddish, no stipe at the base, with a contraction between perianth and ovary, glabrous outside, venation rather faint; utricle subglobose, c. 7 mm ø, hairy inside, with 2 glandular, round bodies (c. 0.5 mm ø); tube c. 7 by 2 mm, glandular-hairy inside; limb 1-lipped, linear, c. 20 by 4 mm, with glandular hairs on the inner surface. *Stamens* 6; anthers oblong, c. 0.7 mm long. *Gynostemium* c. 1 mm long; style 6-lobed; lobes triangular, c. 0.5 mm long, the basal part of each lobe slightly extended outward (c. 0.3 mm long and wide). *Capsules* yellowish when mature (NGF 45343), hard, tardily dehiscent, cylindric or oblong, not ridged or angular, 2.5–4.5 by 2–3 cm, minutely granular. *Seeds* triangular or deltoid, 7 by 6–7 mm, not winged, rather smooth or obscurely muciculate on both surfaces; funicle broadened and covering the upper surface.

Distr. Solomon Is. (Ysabel, Malaita); in *Malesia*: New Guinea (Sepik, Morobe and Milne Bay Distr.).

Ecol. In primary, sometimes in secondary, forests, on rough, rocky, wet ground, on edge of creek, or along stream, from lowland up to 1500 m. *Fl.* June, *fr.* June, Aug., Sept., Oct.

Vern. Solomon Is.: *kwalokame*, Kwara'ae name.

Notes. Among the New Guinea species the leaves are characteristic: subcoriaceous to coriaceous, prominently palmately 5 (–7)-nerved, with a prominent closely reticulate venation, and a deeply cordate base with the auricles often overlapping.

It seems allied to *A. foveolata*.

**24. *Aristolochia schlechteri* LAUT.** in K. Sch. & Laut. Nachtr. Fl. Schutzgeb. (1905) 260; Bot. Jahrb. 52 (1914) 107; DING HOU, Blumea 29 (1983) 241, f. 6c.

Twiner or scrambling vine. Old stem terete, 1.5 cm ø. Branches terete, 2–5 mm ø, pubescent when young, glabrescent. *Leaves* subcoriaceous or chartaceous, elliptic-lanceolate, oblanceolate, (10–) 17–26 by (2.5–) 5–9 cm; apex acuminate; base cordate with distinct auricles, or shallowly cordate with obscure auricles, sinus (0.5–) 1–2 cm deep; glabrous or sparsely shortly hairy above, short-hairy beneath; nerves prominent beneath, distinct above; basal nerves 1 pair, ascending upward to halfway the blade, lateral nerves 4 or 5 pairs; veins loosely reticulate or crossbar-like, slightly elevated beneath, rather faint above; petiole 2–3.5 cm, shortly hairy. *Inflorescences* in axils of leaves, or cauligerous, usually 1 or 3, simple or spiciform, borne on a knob-like, very short branch; rachides up to 16 cm long, with spacious internodes, densely shortly hairy; bracts very small, triangular or lanceolate, c. 1 mm long, densely hairy. Pedicel and ovary c. 22 mm long, densely hairy. *Perianth* slightly curved, whitish or creamy white with green, brown or purple distinct venation; with a contraction between perianth and ovary; pubescent outside, with rather scattered glandular hairs inside; utricle ellipsoid or obovoid, c. 15 by 8–11 mm; tube 17–23 mm long, variable in width (5–8 mm ø) in one flower; limb prominently 3 + 3-lobed: 3 triangular lobes (20–25 by 15 mm) and 3 alternate lobes (each lobe triangular, 15–20 by 10–15 mm, apical part, c. 50 mm, lacinate and tail-like when dry). *Stamens* 6; anthers oblong, 1.5–2 mm long. *Style* column c. 7 mm long, 6-lobed; lobes lanceolate, 2.5 mm long. Capsules not seen.

Distr. *Malesia*: Papua New Guinea (Sepik, Madang and Morobe Distr.).

Ecol. In primary forest, beside a river or on rocky ridge. *Fl.* Jan., July, Aug., Dec., *fr.* June.

Vern. New Guinea: *pengeramboi*, Sepik Distr., Waskuk, *yogwa*, Wagu.

Note: Among Malesian species this is unique in possessing a 6-lobed perianth. In leaves it cannot be distinguished from *A. momandul*. Whether the capsules or seeds are different could as yet not be ascertained.

**25. *Aristolochia dielsiana* SCHMIDT,** Bot. Jahrb. 58 (1923) 490; in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; DING HOU, Blumea 29 (1983) 235, f. 6a.

Liana, up to 15–40 m high, c. 2 cm ø. Branches c. 5 mm ø, shallowly longitudinally sulcate, shortly hairy. *Leaves* often coriaceous, broad-ovate, ovate, lanceolate, rarely narrow-lanceolate, 19–37 by 4.5–23.5 cm (sometimes up to 100 by 70 cm); apex acuminate, rarely apiculate; base slightly sinuate or shallowly cordate; ± truncate, rarely cordate, sinus 0–1 cm deep; shortly hairy on both surfaces, especially on midrib, nerves and veins; nerves elevated and prominent beneath, slightly elevated above;

basal nerves 1 pair, ascending upward to 1/2–3/4 of the blade, each nerve with a weaker, short branch at the base; lateral nerves 3–5 pairs; veins crossbar-like or reticulate, slightly elevated and prominent beneath, main veins distinct above; petiole 2.5–6 cm, often densely shortly hairy. *Inflorescences* cauligerous, 1 or 2 borne on a brachyblast of the (old) stem, rachides up to 11 (–29) cm long, with spaced internodes; bracts very small, densely hairy. Pedicels and ovary 15–30 mm, densely hairy. *Perianth* (bud) straight or slightly curved, greenish white with purple venation, pale green outside with 3 lobes orange-yellow and purple inside, or light yellowish purple with purple veins and becoming dark purple when open; longitudinal veins distinct, loose reticulations faint; shortly hairy outside especially on the veins, glandular hairs scattered inside; utricle obovoid or ellipsoid, 10–15 by 5–10 mm, no glandular bodies inside visible; tube 30–35 mm long, enlarged toward the apical part (c. 15 mm  $\emptyset$ ); limb 3-lobed, lobes triangular to narrow-triangular, 35–50 mm long, 12–14 mm wide at the base, gradually narrowed towards the apex, apical part (25–30 mm) lacinate and often tail-like when dry. *Stamens* 6; anthers oblong, 1.7–2 mm long. *Gynostemium* 5.5 mm long, lower part (c. 1 mm) stipe-like; style 6-lobed, lobes linear, 2.5–3 mm long, no annular ring at the base. *Capsules* green or light yellowish green, oblong, up to 20 (–30) by c. 4 cm, indehiscent (?), 6-ridged, smooth, sparsely shortly hairy, glabrescent. *Seeds* triangular or deltoid, 9 by 8.5–9 mm, slightly longitudinally concave above, convex beneath, smooth on both surfaces, not winged.

*Distr. Malesia:* West New Guinea (Idenburg R.); Papua New Guinea (Sepik, Central & Northern Distr.).

*Ecol.* In primary forest, rarely in secondary forest, from the lowland up to 800 (–1200) m. *Fl.* May, June, July, Oct., Dec., *fr.* June, July, Dec.

*Notes.* In flower bud the present species resembles *A. schlechteri*, but the latter has in anthesis 6 perianth lobes.

It is the host of one of the largest butterfly species of *Rhopalocera*, *Ornithoptera alexandra*, in New Guinea. Mr. R. STRAATMAN reported upon it, under the erroneous name '*A. schlechteri*' (J. Lepidopt. Soc. 25, 1971, 58–64) that 'the flower is shaped like a starfish with three long arms and is dark purple-brown with a yellow heart. The green fruit is shaped like a cucumber, 20–30 cm long, strongly ribbed lengthwise and has a rough skin. It matures slowly and when fully rotten the seeds fall to the ground and are carried away by rainwater over generally short distances, resulting in a number of plants growing in a restricted area.'

Flower colour is not always reported the same: HOOGLAND & CRAVEN noted the perianth to be pale

green outside, the lobes orange-yellow and purple inside, BRASS said flowers greenish white, tinged and veined with purple.

**26. *Aristolochia engleriana*** SCHMIDT in Fedde, Rep. 23 (1927) 288; DING HOU, Blumea 29 (1983) 238, f. 5b, 7b. — *A. ledermannii* SCHMIDT, Bot. Jahrb. 58 (1923) 489, *non* ENGLER 1911.

Small to moderately high twiner. Old stem subterete or slightly flattened, 8–10 mm  $\emptyset$ , shallowly furrowed. Branches terete, 1.5–2.5 mm  $\emptyset$ , rather smooth, shortly hairy when young, glabrescent. *Leaves* subcoriaceous or chartaceous, lanceolate, ovate-elliptic, obovate to oblanceolate, (5–) 8–15 (–19) by (2–) 4.5–6 (–7) cm; apex acuminate, cuspidate; base obtuse, rounded, cuneate, or broadly truncate; glabrous above, sparsely minutely hairy on midrib, nerves and veins below, glabrescent; nerves elevated beneath, distinct above; basal nerves 1 pair, ascending to 1/3–3/4 of the blade; lateral nerves 2–5 pairs, sometimes hardly distinct from veins; loosely reticulate or crossbar-like veins slightly elevated beneath, often faint above; petiole terete, 5–25 (–35) mm, shortly hairy. *Inflorescences* in the axils of leaves, or cauligerous, spiciform, rachides up to c. 4 cm long, internodes distinct, shortly hairy; bracts minute, densely hairy. Pedicel and ovary 15–20 mm. *Perianth* almost straight except the slightly curved tube, whitish with violet-brown venation, or orange yellow (but tube light purplish red with scattered white spots), longitudinal veins visible or distinct, reticulations loose, obscure, shortly hairy outside, glandular-hairy inside, with a contraction between perianth and ovary; utricle obovoid or ellipsoid, c. 15 by 7 mm, no glandular bodies seen; tube 15–20 mm long, narrowed at basal part (c. 2.5 mm  $\emptyset$ ), the rest c. 6 mm  $\emptyset$ ; limb 3-lobed, lobes triangular, 5–6 by 8–10 mm, obtuse or retuse (no tail-like appendage seen). *Stamens* 6; anthers oblong, c. 1.5 mm. *Gynostemium* c. 3.5 mm long, with a distinct stipe-like part (c. 1 mm); style 6-lobed; lobes lanceolate, c. 2 mm long, no annular ring at the base. *Capsule* bright orange, ellipsoid, or pyriform (type description), 6–9.5 by 2–4.5 cm, 6-ridged, smooth. *Seeds* triangular, c. 11 by 9 mm, smooth on both surfaces, not winged.

*Distr. Malesia:* West New Guinea (Malingdam); Papua New Guinea (Sepik, Western, Eastern, and Southern Highlands Distr.). Fig. 18.

*Ecol.* Low montane or montane, sometimes mossy forests, (1260–) 1830–2250 m, once at 600–700 m (Mt Bosavi). *Fl.* March, Sept., *fr.* Jan., Sept., Oct.

*Vern.* Papua New Guinea: *ya waenuw kunguwp*, Wola language.

*Notes.* From other New Guinea species easily recognizable by the 3-nerved leaves with a non-cordate base (base rounded, obtuse, broadly truncate, sometimes cuneate) and a pyriform fruit.



Fig. 18. *Aristolochia engleriana* SCHMIDT, localities in New Guinea.

IGARASHI (Food Pl. Papilionidae, 1979, t. 22) gave a photograph, under the name *A. schlechteri*, which is probably the present species.

**27. *Aristolochia gaudichaudii*** DUCHARTRE, Ann. Sc. Nat. Bot. 2 (1854) 72, t. 6, f. 3–5; MIQ. Fl. Ind. Bat. 1, 1 (1858) 1067; KLOTZSCH, Monatsb. Akad. Berl. (1859) 597; DUCHARTRE in DC. Prod. 15, 1 (1864) 481; LAUT. Bot. Jahrb. 52 (1914) 105; ROEPKE, Trop. Natuur 24 (1935) 80, f. 5; SCHMIDT in E. & P. Nat. Pfl. Fam. ed. 2, 16b (1935) 241; IGARASHI, Food Pl. Papilionidae (1979) t. 26 (fig. on the left & top right); DING HOU, Blumea 29 (1983) 238. — *A. roxburghiana* (non KLOTZSCH) WARB. Bot. Jahrb. 13 (1891) 300. — **Fig. 1e.**

Twiner, sometimes creeper, up to 20 m high. Old stem terete, rather smooth, c. 1.2 cm ø. Branches terete, c. 4 mm ø, striate, glabrous. *Leaves* chartaceous, ovate, broad-ovate, triangular or deltoid in outline, 11–22 by 10–18 cm; apex acute or short-acuminate; base subtruncate (especially when young), subcordate or cordate (usually adult leaves; with the sinus up to 2.5 cm deep; sometimes with 2 divergent, rounded auricles); glabrous; midrib and nerves palmate; basal nerves 2 pairs, similar to the midrib, inner pair ascending to the apex, outer pair much shorter, elevated beneath, distinct above; lateral nerves hardly distinguishable from the veins; veins slightly elevated beneath, distinct or faint above, major veins connecting the inner pair of nerves and midrib, ± transverse at the lower 1/3 or 1/2 of the blade, reticulations rather loose; petiole 2.5–8.5 cm, glabrous. *Inflorescences* in the axils of leaves, with rachis up to 6 cm long, or cauligerous (often with several mostly simple branches, arising from a knob or spot of the stem, up to 14 cm long), branches usually spiciform, with spacious internodes; bracts ovate or triangular, 0.7–1.5 (–5) mm long, glabrous but ciliate on the margin. Pedicel and ovary 10–14 mm, glabrous. *Perianth* straight or slightly curved, with

variable colours recorded as white, yellow, pale green with pinkish tinge, green to brownish, brown red or dark brown red, with a distinct stipe (3–4 mm) slightly dilated at base, longitudinal and reticulate veins distinct, glabrous outside; utricle broad-ellipsoid, 8–15 by 5–9 mm, sparsely hairy inside, with 2 glandular, ellipsoid bodies (c. 1.5 mm long); tube 8–12 by 1.5–2 mm, with scattered glandular trichomes inside; limb 1-lipped, obovate or oblanceolate, 17–20 by 8–12 mm, with scattered glandular trichomes on the inner surface. *Stamens* 6; anthers oblong, c. 1 mm long. *Style* column 3.5–4 mm long, 6-lobed; lobes lanceolate, c. 1.5 mm long, with an annular ring at the base. *Capsules* oblong, 4–6 by c. 3 cm, glabrous. *Seeds* (incl. wing) transverse-oblong, 6–11.5 by 12–16 mm; seed proper deltoid 6–8 by 6–8 mm, smooth on both surfaces, with a central, longitudinal ridge above; wing 2.5–4 mm broad.

**Distr.** *Malesia*: Moluccas (Batjan, Ceram) and New Guinea (Sorong, Manokwari, Fak Fak, Sidei, Toronta, Sepik) and neighbouring islands: Job I., Rawak (Waigeo), Schouten & Biak Is., and New Ireland.

**Ecol.** In primary forest, sometimes in beach, secondary and swampy forests, clearing ground and thickets at low altitudes. *Fl.* April, June, July, Sept., Oct., Dec., *fr.* May, Aug., Sept., Oct., Dec.

**Vern.** New Guinea: *daprijo*, Irian, *surwerro*, Papua.

**28. *Aristolochia linnemannii*** WARB. Bot. Jahrb. 13 (1891) 301; K. SCH. & LAUT. Fl. Deut. Schutzgeb. Südsee (1900) 302; LAUT. Bot. Jahrb. 52 (1914) 105; DING HOU, Blumea 29 (1983) 239, f. 2f.

Scrambler or climber, c. 6 m long. Branches terete, c. 2.5 mm ø, sulcate, glabrous. *Leaves* chartaceous, triangular or deltoid in outline, 5–8 by 4.5–6 cm; apex short-acuminate or acute; base shallowly cordate, sinus broad, up to c. 1 cm deep; glabrous above, minutely hairy beneath; basal nerves 2 pairs, slightly elevated beneath, distinct above; inner pair ascending to the apex, outer pair much shorter, up to c. 1/3 of the blade; veins reticulate beneath, rather faint above; petiole 1.5–2.5 cm, glabrous. *Inflorescences* in the axils of leaves, fasciculate, rachides condensed, very short, usually 2–3 mm long, sometimes one of the branches up to 10 (–15) mm, glabrous; bracts minute, triangular or deltoid, c. 1 mm long, glabrous. Pedicel and ovary 15–30 mm, glabrous. *Perianth* oblique or slightly curved, venation distinct, glabrous outside, with a distinct stipe (c. 2.5 mm) slightly expanded at base; utricle subglobose, c. 6 mm ø, sparsely hairy inside, with 2 glandular, elliptic bodies (c. 2 mm long); tube c. 17 by 2 mm, with scattered, glandular hairs inside; limb 1-lipped, oblong, c. 20 by 10 mm, obtuse or slightly mucronulate, margin reflexed, with scattered, glandular hairs on



the inner surface, glabrescent. *Stamens* 6; anthers oblong, c. 0.7 mm long. *Gynostemium* c. 2.5 mm long; style 6-lobed; lobes triangular, c. 0.5 mm long, basal parts united and extended outward as an annular ring. *Capsules* glabrous, broad-ellipsoid or subglobose, 2.5 by 1.7–2.5 cm, 6-ribbed or 6-angular, obtuse. *Seeds* winged, triangular, c. 6 by 5 mm (incl. c. 1 mm wide wing), seed proper with wart-like granules densely covered beneath, sparsely above, funicle obscure.

Distr. *Malesia*: West New Guinea (Div. Hollandia), Papua New Guinea (Morobe Distr.: former Finschhafen). Two collections.

Ecol. In thickets or along the road at low altitude. *Fl. fr.* July.

#### Doubtful species

The following two species of *Aristolochia* were described by O.C. SCHMIDT (see below). The types were collected at Lordberg, Sepik region, NE. New Guinea, c. 1000 m alt., by LEDERMANN in Nov.-Dec. 1912. These types were lost in B during World War II. Duplicates of them may be extant but as yet have not been found. From the New Guinean (flowering) specimens of *Aristolochia* examined, I cannot find specimens to match the descriptions. I have extracted the essential characters from the original descriptions as follows:

*Aristolochia lauterbachiana* SCHMIDT, Bot. Jahrb. 58 (1923) 488. — Type: LEDERMANN 9883 (B, lost), Sepik region, NE. New Guinea.

Leaves unknown. Inflorescences curled, few-flowered, axis densely pilose; bracts minute, subtriangular, c. 1 mm long and wide, densely pilose. Pedicel c. 13 mm long. Flowers white, red-striate and -spotted, unilabiate, c. 6.5 cm long, densely pilose; utricle obovoid, c. 14 mm long; tube enlarged at the apical part, c. 22 mm long; limb lingulate, c. 20 mm long, apex narrowed; ovary c. 10 by 1.5 mm, densely pilose. Fruit unknown.

*Aristolochia novoguineënsis* SCHMIDT, Bot. Jahrb. 58 (1923) 489. — Type: LEDERMANN 10362 (B, lost), Sepik region, NE. New Guinea.

Leaves subcoriaceous, lanceolate, 16–18 by 3–5 cm, smooth, apex caudate, up to 2.5 cm long, base rounded or truncate, nerves 3 at the base; petiole 3–3.5 cm long. Inflorescences curled, multi-flowered; bracts minute, densely pilose. Pedicel c. 12 mm long. Flowers white, purple-nerved, c. 8.5 cm long, 1-lipped; utricle ovoid, c. 12 mm long; tube curved, c. 18 mm long; limb narrow-lingulate, c. 38 mm long; ovary c. 12 by 2 mm, densely pilose. Fruit unknown.

## TRIURIDACEAE (J.P.M. van de Meerendonk, Leyden)<sup>1</sup>

The *Triuridaceae* are a small family (c. 6 genera, and c. 45 *spp.*) of very delicate, saprophytic, terrestrial, mostly dark-red coloured herbs growing in the deep shade of everwet tropical forest, entering the subtropics only in Japan and the Bonin Is. They are in Africa confined to restricted areas in the West and are also in continental Southeast Asia remarkably rare, as yet only known from two localities in Assam and N. Thailand respectively. Fig. 1. The nearest localities to Indochina and China are in Hainan and Botel Tobago Is. (southeast off Taiwan). In Australia they are only found in the Bellenden Ker Range in NE. Queensland, showing their aversion to dry and seasonal climates.

By their small stature (10–40 cm), dark colour, and very small flowers they are evasive to collectors; the only one reaching some size (45–140 cm) is *Sciaphila purpurea* which is found in Peru, according to GIESEN mainly in termite nests in hollow trunks. During exploration, trip stops, either for felling or climbing trees, or for culinary or sanitary purposes, offer the best opportunity to observe them.

Flowering specimens can probably be found throughout the year, as it appeared that of common species such as *Sciaphila arfakiana*, specimens have been collected in all months of the year.

Formerly *Triuridaceae* were usually placed in the affinity with *Liliaceae* by BENTHAM & HOOKER and by ENGLER & PRANTL. HUTCHINSON (1934) raised the family to the order *Triuridales*, alongside *Alismatales* to which he also reckoned the saprophytic genus *Petrosavia*, which usually was accommodated in *Liliaceae*, but deviates from *Liliaceae* in having an apocarpous gynoeceum. He recognized *Petrosavia* as representing a distinct family *Petrosaviaceae*.

Recently this controversial matter was further elaborated by CRONQUIST (1981), who also recognized *Triuridaceae* in the rank of an order, *Triuridales*, but more closely associated *Petrosaviaceae* with *Triuridaceae* and finds 'the resemblance so complete that I would have no hesitation in placing *Petrosavia* in the family *Triuridaceae* on the basis of anatomical evidence.' This view is shared by DAHLGREN & CLIFFORD (1982). The removal of *Petrosavia* from *Liliaceae* to the affinity of *Triuridaceae* is here also supported by MULLER (*vide infra*) who found that the pollen of *Triuridaceae* shows some similarity to that of *Petrosavia* and *Vallisneria* and does not suit that of *Liliaceae*.

The family was meticulously revised by H. GIESEN (1938) who had the rich material (much on liquid) of Herbarium Bogoriense. In addition, the great value of his work is the fact that he reported in detail on many type specimens, of which some in Berlin are now lost and also on those of Florence, which were not sent to me on loan. This enabled me to reach a satisfactory interpretation.

From Malesia GIESEN had some 130 collections at his disposal. The present revision is based on 300 collections. This increase led to a better insight in the variability of characters and made it possible to select those that are reliable, which in turn led to a rather heavy reduction in the number of species and more critical generic and specific delimitations.

As to the genera, *Sciaphila* (incl. *Andruris*) is by far the largest (c. 35 *spp.*), and covers the entire range. Three small genera (1 or 2 *spp.* each) are neotropical, a fifth is confined to the Malagasian area, and the sixth is endemic in the Deccan and Ceylon; both are monotypic.

**Literature:** A. CRONQUIST, An integrated system of classification of flowering plants (1981) 1074; R.M.T. DAHLGREN & H.T. CLIFFORD, The Monocotyledons (1982) 289, 323, 324; H. GIESEN, *Triuridaceae*. Pfl. R. Heft 104 (1938); J. HUTCHINSON, The families of flowering plants. 2. Monocotyledones (1934) 37.

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(1) Revised under the supervision of the late Dr. M. Jacobs; made ready for the press with a general introduction by the General Editor.

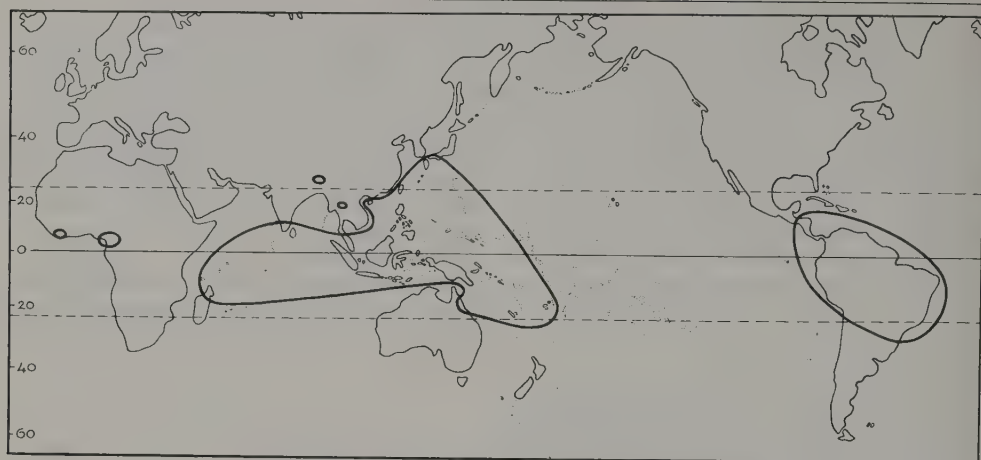


Fig. 1. Approximate range of the family *Triuridaceae*.

### 1. SCIAPHILA

BLUME, Bijdr. 10 (1826) 514; BECCARI, Malesia 3 (1890) 329; SCHLTR, Bot. Jahrb. 49 (1912) 70–84, 3 fig.; GIESEN, Pfl. R. Heft 104 (1938) 30; MEERENDONK, Ident. Lists Males. Specim. n. 63 (1983). — *Aphyllia* CHAMPION, Calc. J. Nat. Hist. 7 (1847) 468. — *Andruris* SCHLTR, Bot. Jahrb. 49 (1912) 71; GIESEN, Pfl. R. Heft 104 (1938) 15. — **Fig. 1–4.**

Small and delicate, echlorophyllose, mostly erect, simple or branched herbs up to c. 45 cm high (in Mal.). Rhizome often with a few scale-like leaves, sometimes branched, mostly with hairs. Stem usually glabrous, sometimes with air-roots, descending from both sides of the leaves (up to 5 cm of the stem). *Leaves* scale-like, scattered, spaced, sessile, mostly appressed, sometimes amplexicaul. *Inflorescences* terminal, racemose, all around or most flowers to one side, with male and female flowers, or male and bisexual flowers, or only bisexual flowers. Monoecious; female flowers usually in the upper part of the raceme. *Flowers* actinomorphic, perianth with 4–10, usually 6, valvate, patent or reflexed, equal or alternately unequal (larger and smaller) segments, connate at base, at the top glabrous or bearded by uniseriate hairs, or with knob-like appendages. — ♂ *Flowers*: with 2–3 or 6 sessile or  $\pm$  sessile, epitepalous (in *Triuris* alternitepalous) stamens, in case there are 2 or 3 stamens they are in front of the larger segments; anthers 1–4-celled, 2–4-lobed, first opening transversally, later also longitudinally; filaments sometimes far exceeding the dorsifixed anthers, rarely connate at base. — ♀ *Flowers*: with c. 10–80 obovoid, free ovaries, each with 1 orthotropic, later anatropic ovule; style inserted laterally and adaxially, usually exceeding the ovary, club- or awl-shaped, in the former case with many hairs and papillae, in the latter with glabrous apex. — *Bisexual flowers*: with (2–) 3–6 persistent stamens with clearly visible filaments, anthers 1-celled, 2–3-lobed; ovaries c. 10–50, like in the female flowers, but the style always



club-shaped. *Fruits* obovoid, 3–8 times as large as the ovaries, with persistent, partly shrivelled style, dehiscent lengthwise from the apex, first abaxially, later also adaxially. *Seed* 1, endospermous, elliptic to ovate, the surface netted and mostly lined, sometimes with a dent. Endosperm absent; embryo anatropous (first orthotropous).

*Distr.* About 33 *spp.*; pantropical and subtropical in Southern Japan and Bonin Is., in Africa only in the West (Ivory Coast, Nigeria, Cameroun), in continental Southeast Asia only in Assam and N. Thailand, in Hainan and Botel Tobago Is., throughout Malesia (14 *spp.*), not in the Central Pacific, but rather well represented in Micronesia and Melanesia, and Western Polynesia; in Australia only locally in Queensland (Bellen-den Ker Ra., c. 16° S). Fig. 2.

*Ecol.* Saprophytes in humous soil between litter of rain-forest, often associated in local saprophyte 'colonies' with species of *Burmanniaceae*, tiny orchids, and *Epirixanthes* (*Polygal.*). Mostly at low altitude, ascending to c. 1200 m, very rarely higher, up to 2200 m altitude.

The root system carries endotrophic mycorrhiza.

*Morph. & Anat.* Several large papers have been devoted to the morphology and anatomy, notably by JOHOW (1889), POULSEN (mainly on the embryology) (1906), WIRZ (1910), and TOMLINSON (1982).

The anatomy is reduced and stomata are absent. Whether the plants are annual or perennial is not clear; probably they are annual.

The pollen is that of a Monocot, the grains being inaperturate, as in *Scheuchzeria*, monosulcate in *Sciaphila*, and trinucleate as in most *Alismatiflorae*.

The ovule is orthotropous first, anatropous later. The single integument is two cell layers thick. The seed, c. 1 mm in size, lacks endosperm and the cells of the testa are filled with air, which might favour wind dispersal, anyway at very short distances only, with respect to its 'concealed' habit and small size of the plants.

*Literature:* JOHOW, Pringsh. Jahrb. Bot. 20 (1889) 475–525, t. 19–22; POULSEN, Medd. Naturl. Foren. Kbhvn 49 (1906) 1–16, t. 6; P.B. TOMLINSON in Metcalfe (ed.), Anatomy of the Monocotyledons, VII. *Helobiaeae* (1982) 466–473, t. 15; WIRZ, Flora 101 (1910) 395–446, f. 1–22, t. 4.

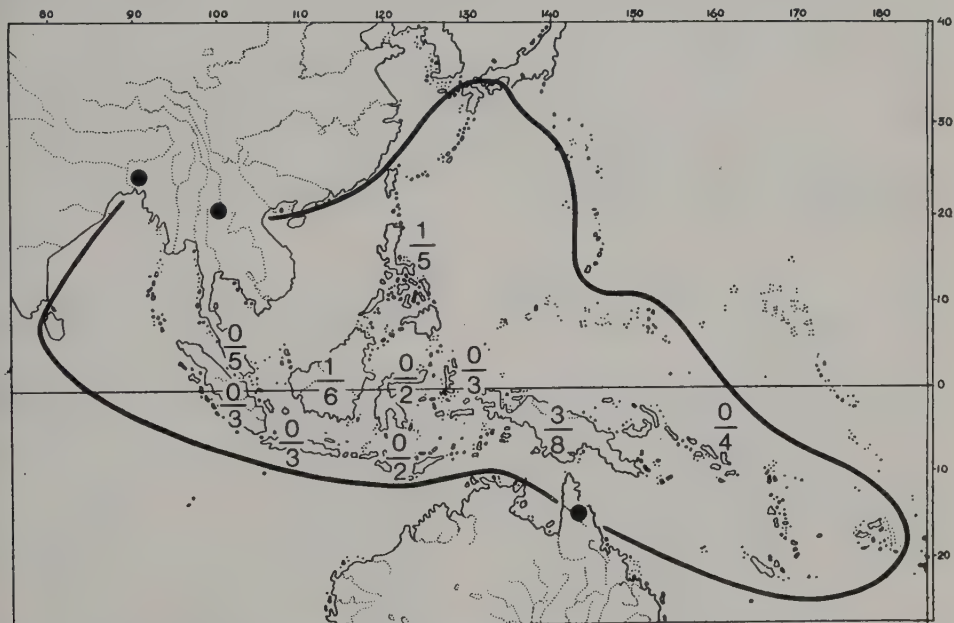


Fig. 2. Distribution of *Sciaphila* BL. east of Africa; outline of range, with the only known localities in India, Thailand, and Australia represented by a dot. For the Malesian subareas number of endemics above the hyphen and number of non-endemics below the hyphen.

**Palyn.** Pollen of *Sciaphila* is trinucleate, boatshaped-ellipsoidal, 25–40  $\mu$ m long with an indistinctly outlined colpate aperture. The exine is very thin, probably intectate and covered with microverrucae. In *S. arfakiana* and *S. corniculata* the microverrucae are coarser on the apertural side of the grain and finer on the opposite side and they are densely spaced in a hexagonal pattern. In *S. densiflora*, *S. tenella* and *S. winkleri* the microverrucae are of uniform size and more or less densely spaced. The pollen of *S. multiflora* is transitional between these two types.

*Sciaphila* pollen is similar in the microverrucate sculpture to that of *Triuris*, but the latter is spherical and inaperturate. The pollen of *Hyalisma* which is also spherical and inaperturate differs in the rather coarse, dimorphic gemmate-echinate sculpture.

The pollen of *Triuridaceae* shows some similarity to that of *Petrosavia* (*Liliaceae*) and *Vallisneria* (*Hydrocharitaceae*).

**Literature:** G. ERDTMAN, Pollen morphology and plant taxonomy, Angiosperms (1952) 439. — J. MULLER.

**Chromosomes.** Chromosome numbers are few and only known from *Sciaphila*. OHBA & SINOTO found for the non-Malesian *S. japonica*  $2n = 48$ ; LARSEN for *S. thaidanica* from N. Thailand  $2n = 28$ ; GREEN & SOLBRIG for the New Caledonian *S. dolichostyla*  $2n = 44$ , while SOLBRIG noted for *S. densiflora* (in sched. P.S. GREEN 1329) the number as  $2n = 22$ .

**Literature:** P.S. GREEN & O.T. SOLBRIG, J. Arn. Arb. 47 (1966) 266–269, f. 1–3; K. LARSEN, Dansk Bot. Ark. 30 (1963) 249; OHBA & SINOTO, Bot. Mag. Tokyo 38 (1924) 203.

**Taxon.** Following SCHLECHTER (1912), GIESEN (1938) distinguished between *Sciaphila* BL. and *Andruris* SCHLTR, on account of the absence *cq.* presence of what he called an awl-shaped prolonged connective. Actually the anther is dorsally attached near the base of the usually very long filament. The apical part of the latter is easily shed, as GIESEN himself already noted, and hence the structure is often difficult to recognize.

Using this feature as a character on generic level would in my opinion lead to artificial distinctions. This becomes clearly evident in comparing the type specimens and/or descriptions for example of *Sciaphila arfakiana* and *Andruris anisophylla*, and of *S. tuberculata* and *A. clemensiae*, which are all otherwise identical; in fact they represent only a single species, *Sciaphila arfakiana*.

GIESEN had subdivided the genus into a number of sections and subsections which can be retained. The species accepted for Malesia are accommodated in the key almost all according to his subdivision.

**Notes.** As essential characters for specific distinction are mainly found in the structure of the androecium, collectors should gather ample material and ensure that male flowers are represented, and check whether plants with bisexual flowers are extant. Hitherto these are only found in *S. maculata* and *S. tenella*. The structure of the stamens can be best observed in mature buds or very young flowers.

The great influx of material since GIESEN's monograph has led to a rather heavy reduction in the number of accepted species in Malesia and adjacent countries. GIESEN recognized for Malesia 49 *spp.* and 2 doubtful ones; one, *S. buruensis* being added later. In the present revision I recognize 14 *spp.*, plus a doubtful one.

In the 'Identification Lists of Malesian Specimens' n. 63, published simultaneously with this revision, all names in *Sciaphila* of Malesia and adjacent regions in the West Pacific are listed, with indication of their types and disposition.

#### KEY TO THE SPECIES

1. Plants with bisexual flowers. Mostly also male flowers present towards the apex. *Sect. Hermaphroditantha* subsect. *Polyandra*.
2. Male and bisexual flowers with 3 stamens ..... 1. *S. maculata*
2. Male flowers with 6 stamens. Bisexual flowers with 3–6, but generally 6, stamens ..... 2. *S. tenella*
1. Flowers unisexual (the female towards the base, the male towards the apex).
3. Perianth of the male flower consisting of 4–8 equal segments. *Sect. Oliganthera* subsect. *Quadrilobatae* (incl. also 14. *S. micranthera*).
4. Stamens 2. Male perianth segments at the apex with a knob ..... 3. *S. quadribullifera*
4. Stamens 3. Male perianth segments at the apex bearded or glabrous.
5. Male flowers always with 6 perianth segments. Style awl-shaped, in general 2–3 times as long as the carpel ..... 4. *S. corniculata*
5. Male flowers with 4–8 perianth segments. Style club-shaped, generally as long as the carpel ..... 5. *S. secundiflora*
3. Perianth of the male flower consisting of 3 larger segments alternating with 3 smaller ones.
6. At least 3, mostly 6, of the male perianth segments at the apex with a stipitate globose to ellipsoid knob.
7. Female perianth segments with a minute knob at the apex (look at buds) ..... 6. *S. wariana*

7. Female perianth segments at the apex without appendages.
8. Only the 3 smaller male perianth segments at the apex with a stipe and a small ellipsoid knob. The 3 larger perianth segments without appendages ..... 7. *S. nana*
8. All male perianth segments with a stipe and knob ..... 8. *S. arfakiana*
6. Male perianth segments at the apex without a stipe or knob, but long-bearded.
9. Stamens 6. *Sect. Hexanthera*.
10. Young anthers 3-lobed. Flowers all around the stem, rarely most flowers to one side (second)  
..... 9. *S. densiflora*
10. Young anthers 2-lobed. Flowers generally all to one side (second) ..... 10. *S. corallophyton*
9. Stamens 3.
11. Young anthers 2- or 3-lobed.
12. Anthers 2-lobed. *Sect. Oliganthera subsect. Bilobatae* ..... 11. *S. winkleri*
12. Anthers 3-lobed. *Sect. Oliganthera subsect. Trilobatae*.
13. Pedicels c. 5–8 mm long ..... 12. *S. consimilis*
13. Pedicels c. 2–4 mm long ..... 13. *S. multiflora*
11. Young anthers 4-lobed. (Belongs to *sect. Oliganthera subsect. Quadrilobatae*, see lead 3)  
..... 14. *S. micranthera*

**1. *Sciaphila maculata*** MIERS, Proc. Linn. Soc. 2 (1850) 72 (*n.v.*), repr. Ann. Mag. Nat. Hist. II, 7 (1851) 324; Trans. Linn. Soc. 21 (1852) 48; BTH. in Hook. J. Bot. Kew Misc. 7 (1855) 10; MIQ. Fl. Ind. Bat. 3 (1856) 232; F. v. M. in Walp. Ann. 5 (1860) 917; SCHNIZL. Iconographia 1 (Suppl.) (1860–67) pl. 57: f. 27, 28; VIDAL, Rev. Pl. Vasc. Filip. (1886) 282; ENGL. in E. & P. Nat. Pfl. Fam. 2, 1 (1889) 238, f. 179: A–F; BECC. Malesia 3 (1890) 331; MERR. En. Philip. 1 (1923) 28; GIESEN, Pfl. R. Heft 104 (1938) 39, f. 7: 1–3. — *S. affinis* BECC. Malesia 3 (1890) 331, pl. 39: 14–18; RIDL. J. Str. Br. R. As. Soc. n. 33 (1900) 197; Mat. Fl. Mal. Pen. (Monoc.) 2 (1907) 126; J. Fed. Mal. St. Mus. 6 (1915) 188; MERR. En. Borne. (1921) 38; RIDL. Fl. Mal. Pen. 4 (1924) 364; GIESEN, Pfl. R. Heft 104 (1938) 37; HEND. Mal. Wild Fl. (Monoc.) (1954) 203, f. 121. — *S. hermaphrodita* SCHLTR., Bot. Jahrb. 49 (1912) 76, f. 3: K–O; J. J. SMITH, Nova Guinea 14 (1927) 325; GIESEN, Pfl. R. Heft 104 (1938) 38, f. 7: 9–10. — *S. minuta* SCHLTR., Bot. Jahrb. 49 (1912) 84, f. 2: O–S; GIESEN, Pfl. R. Heft 104 (1938) 68. — *S. decipiens* BACK. Handb. Fl. Java 1 (1925) 66; STEEN. Trop. Natuur 23 (1934) 51; GIESEN, Pfl. R. Heft 104 (1938) 37; BACK. & BAKH. f. Fl. Java 3 (1968) 8.

Erect herb, c. 3–16 cm high, mostly simple, sometimes branched at the base. Roots filiform, c. 0.2–0.3 mm in CS, seldom branched, glabrous. Stem c. 0.4–0.9 (–1.1) mm in CS, mostly glabrous, internodes c. 3–29 mm. *Leaves* oblong, acuminate to acute, c. 1–2.5 by 0.5–0.9 mm, sometimes semi-amplexicaul, appressed, but top often patent. *Raceme* c. 2–8 cm; flowers c. 6–40, all around, sometimes secund. Bracts lanceolate, acute, c. 0.8–2 by c. 0.2–0.5 mm, appressed to the pedicel. Pedicels c. 2–9 mm, c. 0.15–0.25 mm in CS, patent at c. 45–60 (–70)°, straight for almost the whole length. — ♂ *Flowers* (sometimes absent): perianth segments 6, 3 larger ones alternating with 3 smaller ones, all completely

reflexed and bearded at the top; larger segments long-triangular, acuminate, c. 0.75 by c. 0.15 mm; smaller segments triangular, acute, c. 0.65 by c. 0.20–0.25 mm. Stamens 3, c. 0.2 mm; filaments short; anthers 3-lobed. — *Bisexual flowers*: perianth similar to that of the male flower but smaller differences between large and small perianth segments. Stamens 3, very rarely 2, c. 0.2–0.3 mm; filaments short; anthers 2–3-lobed. *Carpels* c. 10–30, c. 0.3–0.6 mm long; style inserted laterally at the base or just above the base, when young just exceeding the carpel, club-shaped, the apex beset with hairs and papillae.

Distr. *Malesia*: Malaya (all parts), Borneo (Sarawak), New Guinea (NE. part).

Ecol. Rain-forest (sometimes on ridges), on humus or between dead leaves, 100–1200 m. *Fl.* April, July, Nov., Dec.

Notes. When fresh plant wine-red, crimson or dark-purplish red; flowers red or purplish red.

It is possible to distinguish between *S. maculata* (incl. *S. minuta*) and *S. affinis* (incl. *S. hermaphrodita* and *S. decipiens*) because male flowers are absent in the latter. In the Identification List such specimens have been marked (f). In my opinion, all are conspecific.

I did not see the types of *S. affinis* and *S. decipiens*, but GIESEN, who did, thought them to be conspecific.

**2. *Sciaphila tenella*** BL. Bijdr. 10 (1826) 515; Mus. Bot. 1 (1851) 321, f. 48; MIERS, Trans. Linn. Soc. 21 (1852) 48; BTH. in Hook. J. Bot. Kew Misc. 7 (1855) 10; MIQ. Fl. Ind. Bat. 3 (1856) 232; F. v. M. in Walp. Ann. 5 (1860) 917; SCHNIZL. Iconographia 1 (Suppl.) (1860–67) pl. 57: t. 13–16, 19–25; BECC. Malesia 3 (1890) 331; JANSE, Ann. Jard. Bot. Btzg 14 (1896) 85; HEMSL. Ann. Bot. 21 (1907) 75, pl. 10: 11–17; WENT, Nova Guinea 8 (1909) 165; KOORD. Exk. Fl.



Java 1 (1911) 96; MERR. En. Born. (1921) 38; BACK. Handb. Fl. Java 1 (1925) 66; J. J. SMITH, Nova Guinea 14 (1927) 326; STEEN. Trop. Natuur 23 (1934) 51; GIESEN, Pfl. R. Heft 104 (1938) 40, f. 7: 11–12, incl. var. *robusta* GIESEN et var. *voigtii* GIESEN, l.c. 41; MERR. & CHUN, Sunyatsenia 5 (1940) 15; BACK. & BAKH.f. Fl. Java 3 (1968) 8; ANONYMOUS, Fl. Hainanica 4 (1977) 63, f. 985. — *Aphylllea erubescens* CHAMP. Calc. J. Nat. Hist. 7 (1847) 468. — *S. erubescens* (CHAMP.) MIERs, Trans. Linn. Soc. 21 (1852) 48; BTH. in Hook. J. Bot. Kew Misc. 7 (1855) 10; MIQ. Fl. Ind. Bat. 3 (1856) 232; F. v. M. in Walp. Ann. 5 (1860) 917; SCHNIZL. Iconographia 1 (Suppl.) (1860–67) pl. 57: f. 27; THW. En. Pl. Zeyl. (1861) 294; ENGLER in E. & P. Nat. Pfl. Fam. 2, 1 (1889) 238, f. 179; G–H; Hook. f. Fl. Br. India 6 (1893) 558; in Trimen, Fl. Ceyl. 4 (1898) 368; ALSTON, Fl. Ceyl. Suppl. (1931) 298; GIESEN, Pfl. R. Heft 104 (1938) 41, f. 8: 1–3. — *S. subhermaphrodita* J. J. SMITH, Nova Guinea 14 (1927) 326, pl. 36: 4. — *S. torricellensis* K. SCH. & SCHLTR in K. Sch. & Laut. Fl. Schutzgeb. Nachtr. (1905) 54, pl. 2; GIESEN, Pfl. R. Heft 104 (1938) 42, f. 8: 4, 5, 9. — *S. pumila* GIESEN, Pfl. R. Heft 104 (1938) 39, f. 7: 4–6. — **Fig. 3 B1–5.**

Erect herb, at the base a little flexuous, rarely branched, (1.5–) 5–24 cm high. Roots filiform, c. 0.1–0.3 mm in CS, sometimes branched, glabrous or with a few hairs. Stem c. (0.3–) 0.5–1.5 mm in CS, glabrous, internodes c. 3–25 mm long. *Leaves* ovate to oblong, acute to acuminate, 1–3 by 0.7–2.0 (–2.5) mm, amplexicaul or semi-amplexicaul, appressed. *Raceme* c. 1–16 cm long, with c. 5–50 flowers, flowers more or less all around. Bracts oblong-ovate to oblong, acute, c. 1–2 (–3) by c. 0.3–0.9 mm, mostly appressed to the pedicel, often the top a bit patent, rarely patent to the pedicel at 20–30°. Pedicels c. 2–7 (–8–15) mm long and c. 0.10–0.35 mm in CS, patent at (30–) 50–90°, straight or recurved for a smaller part to halfway. — ♂ *Flowers*: perianth segments 6, all bearded at the top and completely reflexed, 3 larger segments alternating with 3 smaller, the larger ones long-triangular, acute, c. 0.6–1.5 (–1.8) by 0.2–0.4 (–0.6) mm; the smaller ones triangular, acute, 0.5–1.1 (–1.5) by c. 0.2–0.6 mm. Stamens 6, c. 0.2–0.3 mm, filaments c. 0.1 mm long, connate at the base; anthers 3-lobed. — *Bisexual flowers* c. 1–3 mm in size; perianth like in the male flower, but larger segments c. 1.1–2 by c. 0.3–0.7 mm; smaller segments 0.8–1.6 by 0.3–0.6 mm. Stamens 3–6, probably always 6, but easily broken off; filaments long; anthers (2–) 3-lobed, c. 0.2–0.3 mm. *Carpels* c. 15–50, obovoid, c. 0.2–0.5 mm long when young, the upper half with tubercles; style inserted at the base, more or less as long as the carpel, the apex with hairs and papillae.

Distr. Ceylon and *Malesia*: Sumatra (Eastcoast, Bencoolen), Malaya (Pahang, Johore, Singapore),

W. Java, Borneo (Sarawak, Sabah), Philippines (Mindanao), Celebes (Central part and SE. Peninsula), Moluccas (Obi I.), New Guinea (all parts except the SW., also in New Britain and Bougainville I.) and the Solomon Is. (Guadalcanal and San Cristobal Is.).

Ecol. (Solitary) plant, in shade of dense (sometimes somewhat disturbed) rain-forest, often on hill-sides, on clay, chalk or porous nickel-rich soil, sometimes ultra-basic soil, at various altitudes between 15 and 2250 m. Fl. May–Feb.

Notes. Fresh plant red, purple or pinkish to coral-pink, flowers red or bright pink, fruits red or pinkish.

GIESEN distinguished between *S. tenella* and *S. erubescens* by the presence or absence of hairs at the apex of the perianth segments. But he thought it possible that their absence on the type specimen of *S. erubescens* was due to the fact that it possessed only very old flowers. In other specimens I found young flowers with, and old flowers without hairs, on the same plant. Therefore I decided that only one species is concerned.

In the absence of male flowers several specimens are suggestive of *S. picta* from South America. For the time being, we regard these as *S. tenella* with female flowers only; in the Identification List such specimens are marked with (f).

**3. *Sciaphila quadribullifera*** J. J. SMITH, Nova Guinea 14 (1927) 324, pl. 35: 1; GIESEN, Pfl. R. Heft 104 (1938) 56, f. 13: 1.

Branched, erect at the base, somewhat flexuous herb, 6–15 mm high, glabrous all over. Roots filiform, c. 0.2–0.3 (–0.4 in liquid) mm in CS, with many long (c. 0.4 mm) hairs, sometimes branched. Stem c. 0.4–0.8 mm in CS, internodes c. 3–23 mm long. *Leaves* oblong, acute to acuminate, c. 1–3 by c. 0.5–0.9 mm, not amplexicaul, appressed. *Raceme* c. 0.5–1.5 cm long, flowers c. 5–28, all around. Bracts lanceolate, acute, c. 1–2 by c. 0.3–0.4 mm, appressed to the pedicel. Pedicels straight, c. 1.5–3.5 mm long and c. 0.2–0.3 mm in CS, patent at c. 30–45°. — ♂ *Flowers*: perianth segments 4, equal, oblong-ovate, acuminate, at apex with a stipitate globose knob, c. 0.6–0.8 by c. 0.4–0.5 mm. Stamens 2, inserted in front of two opposite perianth segments; filaments short; anthers 4-celled, 4-lobed. — ♀ *Flowers*: perianth as in the male flower, but segments acute, 0.6–0.85 by c. 0.35–0.6 mm, apex without a stipe and knob. *Carpels* c. 30–50, c. 0.4–0.6 mm, upper half with tubercles; style inserted laterally about halfway, when young exceeding the carpel, almost club-shaped, apex with papillae.

Distr. *Malesia*: New Guinea (NW. and NE. part).

Ecol. In forest, 300–1000 m.



Fig. 3. *Sciaphila secundiflora* Thw. ex Bth. A1. Female flower at anthesis,  $\times 10$ , A2. carpel with style,  $\times 20$ , A3. fruits,  $\times 5$ , A4. seed,  $\times 20$ , A5. young male flower, with stamens closed,  $\times 10$ , A6. male flower, with stamens dehiscent,  $\times 10$ . — *S. tenella* Bl. B1. Bisexual flower, the stamens recurved and seen at their apex, B2. young stamen, seen from inside, B3. the same, from outside, B4. the same, from above, B5. stamen, dehiscent, from inside, all  $\times 10$ . — *S. arfakiana* Becc. C1. Female flower,  $\times 10$ , C2. carpel with style,  $\times 20$ , C3. male flower with young stamens,  $\times 10$ , C4. young stamen, from outside, C5. the same, from inside, C6. older stamen, dehiscent, from inside, all  $\times 20$  (A1, 2, 5, 6 VAN ROYEN & SLEUMER 6459, A3, 4 VERSTEEG 1231, B1 BSIP 1104, B2–5 NGF 29310, C1–6 SCHMUTZ 3655).

4. *Sciaphila corniculata* BECC. Malesia 3 (1890) 336, pl. 39: 5–13; GIESEN, Pfl. R. Heft 104 (1938) 56. — *S. neo-caledonica* SCHLTR, Bot. Jahrb. 39 (1906) 19; GUILLAUM. Bull. Soc. Bot. Fr. 84 (1937) 256; GIESEN, Pfl. R. Heft 104 (1938) 54; GUILLAUM. Fl. Nouv. Caléd. (1948) 22. — *S. oligochaete* SCHLTR, Bot. Jahrb. 49 (1912) 82, f. 3: E–J; GIESEN, Pfl. R. Heft 104 (1938) 54, f. 12: 8. — *S. gatiensis* SCHLTR, Bot. Jahrb. 49 (1912) 84, f. 2: X–A'; J.J. SMITH, Nova

Guinea 14 (1927) 325; GIESEN, Pfl. R. Heft 104 (1938) 56. — *S. conferta* J.J. SMITH, Nova Guinea 14 (1927) 324, pl. 35: 2; GIESEN, Pfl. R. Heft 104 (1938) 54.

Erect, branched herb, 2.5–13 cm high. Roots filiform, 0.15–2 mm in CS, with a few hairs. Stem glabrous, c. 0.3–0.6 mm in CS, internodes c. 3–20 mm long. Leaves oblong, acute, c. 0.8–1.5 by c. 0.4–0.7 mm, not amplexicaul, appressed. Raceme c. 0.5–3.5

cm long. Flowers c. 3–9 (–18), all around. Bracts oblong to oblong-lanceolate, acute, c. 1–1.5 by c. 0.3–0.7 mm, appressed to the pedicel. Pedicels straight, c. 1–2 (–3) mm long and c. 0.15–0.25 mm in CS, patent at (10–) 30–45 (–90)°, flowers not hanging. —  $\sigma$  *Flowers*: perianth segments 6, all equal, oblong, acute, c. 0.5–0.8 by c. 0.25–0.4 mm, at the top bearded, patent to reflexed. Stamens 3, c. 0.25–0.3 mm; filaments short, at the base connate; anthers 4-celled, 4-lobed. —  $\varphi$  *Flowers*: perianth as in the male flower but segments 0.5–1.2 mm long and the top glabrous. *Carpels* c. 25–60, c. 0.2–0.3 mm long (when young); style inserted laterally, awl-shaped, in general 2–3 times as long as the carpel, with tubercles over its whole length.

Distr. Solomons (Kolombangara I.) and *Malaysia*: New Guinea (NW. and NE. parts, Waigeo I.) and Moluccas (Obi and Aru Is.).

Ecol. Mixed primary forest and *Sapotaceae*-dominated forest, sometimes on limestone rocks, growing on humus or among dead leaves, in shade, 75–600 m. *Fl.* Nov.–Feb., June.

Notes. Fresh plant violet or scarlet. Leaves dark wine-red or black, flowers carmine, fruits whitish, with wine-red spots.

WENT Sr came to the erroneous conclusion that *S. corniculata* was conspecific with *S. nana*, and this was copied by KOORDERS and Mrs. KOORDERS-SCHUMACHER; they accepted the name *S. corniculata* although this is younger than *S. nana*, and claimed the species for Java, where it does not occur. See under *S. nana*.

5. *Sciaphila secundiflora* THW. ex BTH. in Hook. J. Bot. Kew Misc. 7 (1855) 10; MIQ. Fl. Ind. Bat. 3 (1856) 232; THW. En. Pl. Zeyl. (1861) 294; Hook. f. Fl. Br. India 6 (1893) 558; in Trimen, Fl. Ceyl. 4 (1898) 368; MAKINO, Bot. Mag. Tokyo 14 (1905) 141; ALSTON, Fl. Ceyl. 6 (Suppl.) (1931) 298; GIESEN, Pfl. R. Heft 104 (1938) 60, f. 14: 1–3. — *S. major* BECC. Malesia 3 (1890) 332, pl. 40: 1–11; RENDLE, J. Bot. 39 (1901) 178; RIDL. Mat. Fl. Mal. Pen. (Monoc.) 2 (1907) 126; HEMSL. in Hook. Ic. Pl. 29 (1907) t. 2850: f. 1–6; RIDL. J. Fed. Mal. St. Mus. 6 (1915) 188; MERR. En. Born. (1921) 38; RIDL. Fl. Mal. Pen. 4 (1924) 364; GIESEN, Pfl. R. Heft 104 (1938) 59. — *S. sumatrana* BECC. Malesia 3 (1890) 333, t. 40: 12–20; RIDL. J. Fed. Mal. St. Mus. 8 (1917) 119; GIESEN, Pfl. R. Heft 104 (1938) 63. — *S. papuana* BECC. Malesia 3 (1890) 335, t. 41: 1–5; J.J. SMITH, Nova Guinea 14 (1927) 325; GIESEN, Pfl. R. Heft 104 (1938) 60, f. 14: 4–6. — *S. macra* K. SCH. & SCHLTR in K. Sch. & Laut. Fl. Schutzgeb. Nachtr. (1905) 55, pl. 2, non SCHLTR (1912) which is *S. multiflora*; GIESEN, Pfl. R. Heft 104 (1938) 61, f. 14: 8–11. — *S. monticola* K. SCH. & SCHLTR in K. Sch. & Laut. Fl. Schutzgeb. Nachtr. (1905) 55; J.J. SMITH, Nova Guinea 14

(1927) 325; GIESEN, Pfl. R. Heft 104 (1938) 61. — *S. versteegiana* WENT, Nova Guinea 8 (1909) 165, pl. 47; J.J. SMITH, Nova Guinea 14 (1927) 325; GIESEN, Pfl. R. Heft 104 (1938) 63, f. 14: 12–15. — *S. pilulifera* SCHLTR, Bot. Jahrb. 49 (1912) 77, f. 1: Z–C'; J.J. SMITH, Nova Guinea 14 (1927) 325. — *S. maborensis* SCHLTR, Bot. Jahrb. 49 (1912) 78, f. 1: V–Y; J.J. SMITH, Nova Guinea 14 (1927) 325. — *S. brachystyla* SCHLTR, Bot. Jahrb. 49 (1912) 80, f. 2: J–N; GIESEN, Pfl. R. Heft 104 (1938) 61, f. 14: 7. — *S. wernerii* SCHLTR, Bot. Jahrb. 49 (1912) 80, f. 2: E–H; GIESEN, Pfl. R. Heft 104 (1938) 61. — *S. asterias* RIDL. J. Fed. Mal. St. Mus. 6 (1915) 188; Fl. Mal. Pen. 4 (1924) 365; HEND. J. Mal. Br. R. As. Soc. 17 (1939) 82. — *S. inornata* PETCH, J. Ind. Bot. Soc. 3 (1923) 226; ALSTON, Fl. Ceyl. 6 (Suppl.) (1931) 299; GIESEN, Pfl. R. Heft 104 (1938) 67. — **Fig. 3 A1–6.**

Erect herb, 6–33 cm high, sometimes somewhat ascending, mostly branched, but often one of the twigs at a ramification broken off. Roots filiform, c. 0.2–0.3 (–1) mm in CS, with hairs. Stem glabrous, c. 0.3–1.5 mm in CS, internodes c. 5–50 mm long. *Leaves* oblong to ovate, acute, c. 1.5–3 (–4) by c. 0.5–1.5 (–2) mm, sometimes semi-amplexicaul, appressed or patent to 25°. *Raceme* c. 0.5–19 cm long. Flowers c. 3–35, more or less all around. Bracts oblong-lanceolate to lanceolate, acute, scale-like, c. 1–3 (–4) by c. 0.3–0.7 (–1) mm, appressed to the pedicel, or sometimes patent to 10°. Pedicels c. 1–5 (–6) by c. 0.1–0.3 (–0.5) mm in CS, patent at c. (30–) 45–90°, mostly straight, sometimes very slightly recurved. —  $\sigma$  *Flowers*: perianth segments 4, or 6 or 7, rarely 5 or 8, equal, patent, long-triangular, acute, c. 1.5–5 by c. 0.2–0.6 (–2.2) mm, sometimes at about halfway contracted into a long narrow point, apex glabrous. Stamens 2–3, c. 0.5–0.6 mm; filaments very short (stamens almost sessile); anthers 4-celled, 4-lobed. —  $\varphi$  *Flowers*: perianth segments (4–) 5–10, patent, equal, c. 2.8 by c. 0.3–0.7 (–1) mm, oblong to lanceolate, often at about halfway contracted into an awl-shaped point, apex glabrous. *Carpels* c. 20–80, obovoid, c. 0.35–0.6 (–0.8) mm long, the upper half with many tubercles; style club-shaped, inserted laterally at the base or about halfway, the apex with many hairs and papillae.

Distr. Ceylon, Hongkong; in *Malesia*: N. Sumatra (Atjeh), Malaya (all parts), Borneo (Sarawak, Sabah, W. & E. Kalimantan), New Guinea (N. & SE. parts, Japen and Mios Num Is.), New Britain, New Ireland, Solomons (San Cristobal).

Ecol. Plant of (damp rocky) rain-forest, often on rocky terrain, sometimes dominated by *Pandanus* or *Agathis*, on limestone hills but also known from kerangas forest, 15–1250 m. *Fl.* July–Feb.

Notes. Fresh plant white (when young), red, pale mauve or purplish; flowers white, mauve red or pur-



ple (perianth segments sometimes with dark borders), anthers white, fruits red.

PETCH (1923, see above) regarded *S. inornata* as 'most closely allied to *S. secundiflora*' and 'resembling *S. sumatrana*' but, knowing about the characters he used distinguishing between his species and the two others and from his description of *S. inornata* (though I did not see the type), I think it safe to combine them.

With regard to several species here combined, which were still kept apart by GIESEN, his own key even does not work.

I did not see the type of *S. asterias* RIDL., but I did see RIDLEY 16312 which, according to GIESEN, is almost cotypical with the type.

**6. *Sciaphila wariana* (SCHLTR) MEERENDONK, comb. nov.** — *Andruris wariana* SCHLTR, Bot. Jahrb. 49 (1912) 71, f. 1: A-E; GIESEN, Pfl. R. Heft 104 (1938) 22, f. 3: 15-17; TUYAMA, Bot. Mag. Tokyo 52 (1938) 61.

Erect, branched herb, 8-15 cm high. Roots filiform, c. 0.2-0.4 mm in CS, with long (to 1 mm) hairs. Stem glabrous, 0.4-0.7 mm in CS, internodes 4-15 mm long. *Leaves* oblong-lanceolate, acute, 1-1.5 mm by c. 0.2-0.35 mm, not amplexicaul, appressed, but the top often patent. *Raceme* c. 1-2 cm long. *Flowers* c. 10-15, all around. Bracts lanceolate, acute, c. 1-1.5 by c. 0.20-0.25 mm, appressed or patent to 10°. Pedicels straight, c. 6-8 mm long and c. 0.1-0.15 mm in CS, patent at 45-60°. — ♂ *Flowers*: perianth segments 6, patent, 3 larger ones alternating with 3 smaller ones, all oblong and at the apex with a stipitate (stipe c. 0.15 mm long) subglobose knob; the larger ones c. 0.8-0.9 by c. 0.2-0.25 mm; smaller segments c. 0.7 by c. 0.2 mm. Stamens 3, c. 0.15-0.20 mm; anthers almost sessile, 4-celled, 4-lobed, filament mostly clearly exceeding the anther. — ♀ *Flowers*: perianth segments 6, 0.6-0.8 by c. 0.2 mm, completely reflexed, all equal in shape and size, oblong-lanceolate, the apex with a stipitate (stipe c. 0.03-0.05 mm) very minute knob (mostly only well visible in buds or young flowers). *Carpels* c. 30-40, c. 0.2 mm long (without style); style inserted laterally, c. 0.4-0.9 mm long, the apex acute.

Distr. *Malesia*: New Guinea (NE. part: Goromia at Waria R.; Lordberg at S. Hunstein Mts), 3 collections.

Ecol. In forests, 350-1000 m.

**7. *Sciaphila nana* BL.** Mus. Bot. 1 (1851) 322, f. 48; BTH. in Hook. J. Bot. Kew Misc. 7 (1855) 10; MIQ. Fl. Ind. Bat. 3 (1856) 232; F. v. M. in Walp. Ann. 5 (1860) 917; BECC. Malesia 3 (1890) 338; POULSEN, Medd. Naturh. Foren. Kbhvn (1906) 1; WENT, Versl. Verg. Kon. Ak. Wet., Wis- & Nat. Afd. (1909) 698; BACK. Handb. Fl. Java 1 (1925) 65; STEEN. Trop.

Natuur 23 (1934) 50; GIESEN, Pfl. R. Heft 104 (1938) 18, f. 2: 4-10; BACK. & BAKH. f. Fl. Java 3 (1968) 7. — *S. corniculata* (non BECC.) WENT, Versl. Verg. Kon. Ak. Wet., Wis- & Nat. Afd. (1909) 698; KOORD. Exk. Fl. Java 1 (1911) 96; KOORD.-SCHUM. Syst. Verz. I, §1 (1912) 6. — *Andruris gracillima* GIESEN, Pfl. R. Heft 104 (1938) 18, f. 2: 1-3. — *Andruris nana* (BL.) GIESEN, l.c. — *Andruris loheri* GIESEN, l.c. 19, f. 3: 1-4.

Erect, mostly branched herb, c. 5-15 cm high. Roots filiform, c. 0.2 mm in CS, with hairs. Stem c. 0.2-0.8 mm in CS, glabrous, internodes c. 3-18 mm long. *Leaves* not amplexicaul, appressed, oblong to lanceolate, acute, c. 1-2 by c. 0.3-0.7 mm. *Raceme* c. 0.5-5 cm long. *Flowers* c. 7-35, all around. Bracts oblong-lanceolate to lanceolate, acute, c. 0.6-1.3 by c. 0.2-0.3 mm, appressed to the pedicel or patent to 25° to it, in the latter case mostly perpendicular to the stem. Pedicels c. 2-7 mm long and c. 0.1-0.2 mm in CS, patent at c. 30-60 (-70)°, straight, sometimes slightly recurved at the top. — ♂ *Flowers*: perianth segments 6, 3 larger alternating with 3 smaller, all oblong and patent to reflexed; the larger segments acute, without appendages, c. 0.7-1 by c. 0.3-0.35 mm; the smaller segments at the apex with a stipitate, small, ellipsoid knob, c. 0.5-0.8 by c. 0.2-0.3 mm. Stamens 3, c. 0.3 mm; filaments often exceeding the 4-celled, 4-lobed anthers. — ♀ *Flowers*: perianth segments patent, (4-) 5-6, equal, oblong, acute, c. 0.5-0.6 by c. 0.2-0.35 mm, apex without appendages. *Carpels* c. 20-40 (-70), c. 0.3-0.35 mm; style inserted laterally near the top, awl-shaped, c. 0.4-0.8 mm long, apex acute.

Distr. *Malesia*: Sumatra (Banka), Malaya (Perak, Pahang), W. Java, Philippines (Luzon).

Ecol. Dense forest, sometimes under bamboo, 250-500 m, once at c. 1150 m. Fl. Aug.

Vern. *Tjengtlang*, S.

Notes. Stem and flowers of fresh plant purple.

WENT Sr (see above) came to the conclusion that West Javanese specimens belonged to *S. corniculata* and hinted at the conspecificity of that species with *S. nana*.

**8. *Sciaphila arfakiana* BECC.** Malesia 3 (1890) 337, t. 41: 6-14; GIESEN, Pfl. R. Heft 104 (1938) 57, f. 13: 4. — *S. crinita* BECC. Malesia 3 (1890) 338, pl. 42: 1-9; SCHLTR, Bot. Jahrb. 49 (1912) 71. — *S. andajensis* BECC. Malesia 3 (1890) 339, pl. 42: 10-14; WENT, Nova Guinea 8 (1909) 166; J.J. SMITH, *ibid.* 14 (1927) 323. — *S. clemensae* HEMSL. Hook. Ic. Pl. 29 (1907) pl. 2850: f. 7-14; MERR. En. Born. (1921) 38; En. Philip. 1 (1923) 28; BACK. Handb. Fl. Java 1 (1925) 65; STEEN. Trop. Natuur 23 (1934) 51, f. 9; BACK. & BAKH. f. Fl. Java 3 (1968) 7. — *S. australasica* HEMSL. Kew Bull. (1912) 44; DOMIN, Bibl. Bot. 85 (1926) 256. — *Andruris crinita* (BECC.) SCHLTR,

Bot. Jahrb. 49 (1912) 71; TUYAMA, Bot. Mag. Tokyo 52 (1938) 22. — *Andruris andajensis* (BECC.) SCHLTR, Bot. Jahrb. 49 (1912) 71; TUYAMA, Bot. Mag. Tokyo 52 (1938) 61; GIESEN, Pfl. R. Heft 104 (1938) 28. — *Andruris celebica* SCHLTR, Bot. Jahrb. 49 (1912) 72, f. 1: F-L; TUYAMA, Bot. Mag. Tokyo 52 (1938) 61. — *Andruris tenella* SCHLTR, Bot. Jahrb. 49 (1912) 74, f. 1: M-Q; TUYAMA, Bot. Mag. Tokyo 52 (1938) 61. — *S. inaequalis* SCHLTR, Bot. Jahrb. 49 (1912) 77, f. 1: R-U; J.J. SMITH, Nova Guinea 14 (1927) 324; GIESEN, Pfl. R. Heft 104 (1938) 58, f. 13: 5-7. — *S. atrovioacea* SCHLTR, Bot. Jahrb. 49 (1912) 79, f. 2: A-D; GIESEN, Pfl. R. Heft 104 (1938) 57, f. 13: 2-3. — *S. vitiensis* A.C. SMITH, Bish. Mus. Bull. 141 (1936) 15, f. 5; GIESEN, Pfl. R. Heft 104 (1938) 28. — *Andruris anisophylla* GIESEN, Pfl. R. Heft 104 (1938) 23, f. 4: 2-6. — *Andruris clemensae* (HEMSL.) GIESEN, Pfl. R. Heft 104 (1938) 23, f. 4: 7-9, incl. var. *borneensis* GIESEN, l.c. 25. — *Andruris australasica* (HEMSL.) GIESEN, Pfl. R. Heft 104 (1938) 25, f. 4: 10-13. — *Andruris elegans* GIESEN, l.c. 25, f. 5: 1-4; HOSOKAWA, J. Jap. Bot. 16 (1940) 540. — *Andruris javanica* GIESEN, Pfl. R. Heft 104 (1938) 27, t. 5: 5-9. — *Andruris vitiensis* (A.C. SMITH) GIESEN, l.c. 28; A.C. SMITH, Sargentia 1 (1942) 5; Bull. Torrey Bot. Club 70 (1943) 534; PARHAM, Plants Fiji (1964) 257. — *S. tuberculata* GIESEN, Pfl. R. Heft 104 (1938) 57, f. 12: 9-12. — *S. valida* GIESEN, l.c. 59, f. 13: 8-11. — *Andruris palawensis* TUYAMA, Bot. Mag. Tokyo 52 (1938) 63. — *Andruris buruensis* J.J. SMITH, Bull. Jard. Bot. Btzg III, 16 (1939) 111. — **Fig. 3 C1-6.**

Erect, simple or branched, sometimes a bit flexuous herb, c. (2-) 4-28 cm high. Roots filiform, c. 0.1-0.4 mm in CS, with hairs. Stem c. 0.3-1 (-1.5) mm in CS, glabrous, internodes c. 4-33 mm long. Leaves oblong to lanceolate, appressed, not amplexicaul, c. 1-3 by 0.2-1 mm, acute to acuminate. Raceme c. 0.5-14 cm long; flowers c. 5-65, all around, very rarely all flowers to one side. Bracts oblong-lanceolate, acute, c. 0.5-2.5 by c. 0.1-0.5 mm, appressed to the pedicel (and the top mostly patent) or patent from the pedicel to 40° (and in that case mostly perpendicular to the stem). Pedicels c. 2-21 mm long and c. 0.1-0.3 (-0.4) mm in CS, patent at 20-90° (mostly 30-45°), straight or the apical part recurved. — ♂ Flowers: perianth segments 6, 3 larger ones alternating with 3 smaller ones, all oblong-ovate, the apex with a stipitate globose to ellipsoid knob; larger segments c. 0.7-1.7 by c. 0.3-0.5 mm, smaller segments c. 0.6-1.4 by c. 0.35-0.5 mm. Stamens 3, c. 0.3-0.5 mm; filaments clearly exceeding the 4-celled, 4-lobed anthers (but the acute apex of the filament often broken off). — ♀ Flowers: perianth segments 6, more or less equal, oblong to triangular, acute, c. 0.5-1 by c. 0.25-0.50 (-0.65) mm, apex without appendages, but often thickened. Car-

pels c. (10-) 20-40 (-70), c. 0.2-0.5 mm long; style awl-shaped, acute, inserted laterally, c. 0.6-1.8 mm long, amply exceeding the carpel.

Distr. Micronesia (Palau), W. Polynesia (Fiji Is.: Viti Levu, Vanua Levu, Vanua Mbalavu), Solomons (Bougainville); in *Malesia*: New Guinea (all parts except the SW.; also in New Britain and Manus Is.), Philippines (Mindanao), Moluccas (Ceram, Ambon), Celebes (N. Peninsula and Central part), Lesser Sunda Is. (Flores), West Java, Borneo (Sabah, W., S. & E. Kalimantan), Malaya (Kelantan, Pahang), and Central W. Sumatra.

Ecol. Rain-forest (low montane or montane), often on a hill, cliff, ridge, crest or in a river valley, on sandstone and other bedrock, in shade of trees or fern clumps; on humus, one time on a termite hill. Sometimes associated with *Corsia*, *Burmanna* or *Epirixanthes*; 100-2130 m. Fl. Jan.-Dec.

Notes. Fresh plant pink, pale mauve, red or purple; flowers light brown, red or purple with white or yellowish anthers, fruit reddish blue, red-purple or pale pink (later orange-brown). The plant flowers and then dies; scarce.

In BUWALDA 6161 (from Ambon) and VAN ROYEN & SLEUMER 6268 (New Guinea: Mt Cycloop) the style does not clearly exceed the carpel.

**9. *Sciaphila densiflora*** SCHLTR, Bot. Jahrb. 49 (1912) 87, f. 3: U-X; GIESEN, Pfl. R. Heft 104 (1938) 46, f. 9: 1-2. — *S. reflexa* SCHLTR, Bot. Jahrb. 49 (1912) 87; GIESEN, Pfl. R. Heft 104 (1938) 48, f. 9: 9-10. — *S. longipes* SCHLTR, Bot. Jahrb. 49 (1912) 88; J.J. SMITH, Nova Guinea 14 (1927) 326, pl. 36: 3; GIESEN, Pfl. R. Heft 104 (1938) 46, f. 9: 3. — *S. trichopoda* SCHLTR, Bot. Jahrb. 49 (1912) 89, f. 3: P-T; GIESEN, Pfl. R. Heft 104 (1938) 48, f. 9: 7-8. — *S. flexuosa* GIESEN, Pfl. R. Heft 104 (1938) 45, f. 8: 15-17. — *S. nutans* GIESEN, l.c. 46, f. 9: 4-6. — **Fig. 4.**

Erect herb, seldom branched and if so, then at the base, c. 6-43 cm high. Roots filiform, c. 0.15-0.30 mm in CS, sometimes branched, with hairs. Stem c. 0.5-1.2 mm in CS, glabrous, internodes c. 3-55 mm long. Leaves oblong-ovate to ovate, acute, c. 1.5-5 by c. 0.6-2.5 mm, mostly semi-amplexicaul, appressed. Racemes 1-21.5 cm long, with c. 7-120 flowers, from very dense (100 flowers on 12 cm) to rather lax (35 flowers on 14 cm). Flowers all around, sometimes with a tendency towards one side. Bracts lanceolate, acute, c. 1-2 (-3.5) by c. 0.4-1 (-1.5) mm, mostly appressed to the pedicel, the top often a little (10-20°) patent. Pedicels 3-25 mm long and 0.1-0.2 mm in CS, (45-) 60-90° patent, recurved, straight for a smaller or larger part of the length, sometimes a bit sinuous, the flowers always hanging down. — ♂ Flowers: perianth segments 6, 3 larger ones alternating with 3 smaller ones, all completely reflexed and at the top long-bearded; larger segments

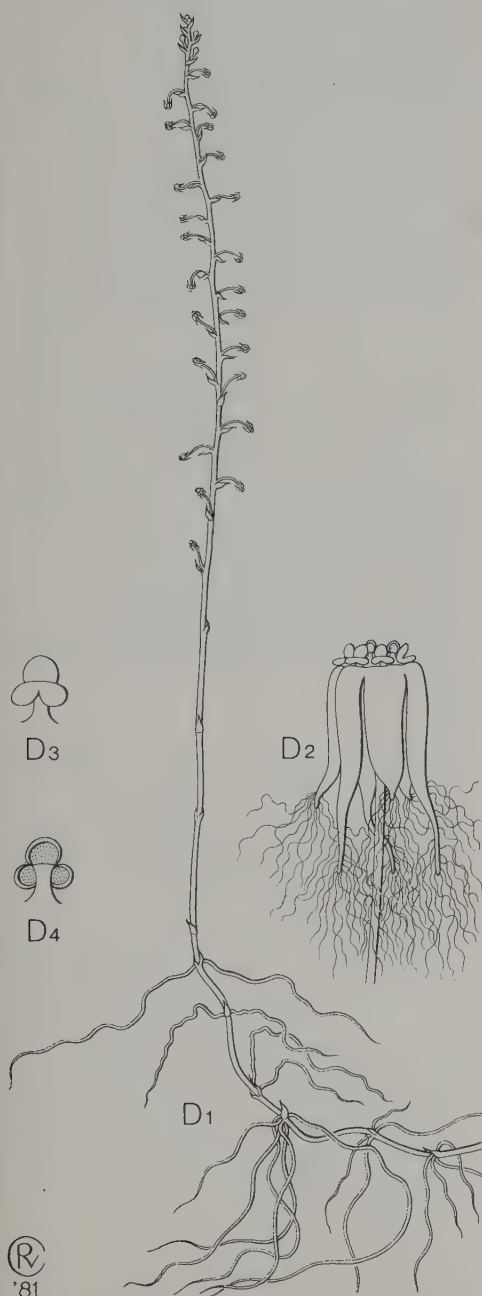


Fig. 4. *Sciaphila densiflora* SCHLTR. D1. Habit,  $\times 1$ , D2. male flower,  $\times 10$ , D3. mature stamen, from outside,  $\times 10$ , D4. the same, from inside,  $\times 10$  (D1 BRASS 28255, D2-4 BW 8553).

long-triangular, (0.6–) 1.3–2 by (0.2–) 0.3–0.5 mm, the top abruptly contracting into a long narrow point (c. 1/3 of the length); smaller segments long-triangular, acute, (0.5–) 0.8–1.5 by c. 0.2–0.4 mm wide. Stamens 6, c. 0.2 mm; filaments short; anthers 3-lobed. — ♀ *Flowers*: perianth like in the male flower, but the larger segments c. 1–2.5 by c. 0.3–0.7 mm and the smaller segments 0.7–1.5 by c. 0.4–0.6 mm. *Carpels* c. 15–40, 0.3–0.55 mm; style club-shaped, inserted laterally at the base or about halfway, exceeding the carpel when young; apex with many hairs and papillae.

*Distr.* Ceylon; in *Malesia*: Lesser Sunda Is. (Timor, Flores), Borneo (Sarawak, W. & E. Kalimantan; Natuna Is.), Philippines (Luzon), Moluccas (Halmahera), New Guinea (all parts except the SW. part; also in Normanby, Rossel and Sudest Is.) and New Caledonia.

*Ecol.* Local and uncommon plant in rain-forest, often on ridge crests, dry ridges, limestone rocks, clay or sandy or poor stony soils, rooting in raw humus or deep leaf litter, mostly in shade, 100–1200 m, once at c. 1950 m. *Fl.* Feb.–Nov.

*Vern.* New Guinea: *ware*, Uruaru lang., Purari River.

*Notes.* Fresh plant coral-pink, purplish or red; flowers red with yellow stamens, fruits red.

In NGF 19532 (K, liquid) the pedicels are almost parallel to the stem.

**10. *Sciaphila corallophyton* K. SCH. & SCHLTR** in K. Sch. & Laut. *Fl. Schutzgeb. Nachtr.* (1905) 54, t. 2: A: a–d; SCHLTR, *Bot. Jahrb.* 49 (1912) 76, 89; GIESEN, *Pfl. R. Heft* 104 (1938) 45, f. 8: 10–12, *incl. var. gracilis* GIESEN, *l.c.*; HANSEN, *Dansk Bot. Ark.* 25 (1969) 88. — *S. dolichostyla* SCHLTR, *Bot. Jahrb.* 39 (1906) 19; SCHINZ in Sarasin & Roux, *Nova Caledonia, Bot.* 1 (1920) 59; GUILLAUM. *Bull. Soc. Bot. Fr.* 84 (1937) 256; GIESEN, *Pfl. R. Heft* 104 (1938) 45, f. 8: 13–14; GUILLAUM. *Fl. Nouv. Caléd.* (1948) 22; *Mém. Mus. Hist. Nat. Paris n.s. Bot.* 8 (1959) 189.

Erect, mostly simple herb, c. 5–23 cm high. Roots filiform, c. 0.15–0.25 mm in CS, with a few hairs. Stem c. 0.5–1.5 (–2) cm in CS, glabrous, internodes c. 4–20 mm long. *Leaves* oblong-lanceolate, acute, c. (1–) 1.5–2.5 by c. 0.5–1.5 mm, not amplexicaul, appressed to the pedicels. *Raceme* c. 0.5–12 cm long, with c. 4–32 flowers, generally most of the flowers to one side. Bracts lanceolate, acute, c. 1–2 by c. 0.4–0.8 mm, appressed to the pedicel, but the top patent. Pedicels c. 2–5 mm long, c. 0.2–0.4 mm in CS, patent at c. 35–45°, recurved but sometimes straight for half the length or less. — ♂ *Flowers*: perianth segments 6, 3 larger ones alternating with 3 smaller ones, all reflexed and at the top bearded; the larger segments oblong-lanceolate, acute, c. 1.1–1.7 by c. 0.3–0.5 mm; smaller segments oblong, acute,



c. 1–1.4 mm by c. 0.3–0.6 mm. Stamens 6; filaments short, anthers 2-lobed. — ♀ *Flowers*: perianth like in the male flower, but the top of the segments glabrous and the larger segments 1.3–1.8 by 0.4–0.6 mm; smaller segments c. 1.1–1.4 by c. 0.4–0.6 mm. *Carpels* c. 30–50, c. 0.3–0.4 mm; style club-shaped, inserted laterally near the base, exceeding the carpel when young, at apex with many hairs and papillae.

Distr. Micronesia: Carolines (Ponape), Melanesia (New Caledonia); in *Malesia*: New Guinea (NE. part).

Ecol. In forest, on rockwalls, along clay streams, 400–2100 m. Fl. Jan.–Dec.

**11. *Sciaphila winkleri*** SCHLTR, Bot. Jahrb. 48 (1912) 88; MERR. En. Born. (1921) 38; GIESEN, Pfl. R. Heft 104 (1938) 52, f. 11: 5–7. — *S. hydrophila* SCHLTR, Bot. Jahrb. 49 (1912) 85, f. 2: T–W; GIESEN, Pfl. R. Heft 104 (1938) 51, f. 11: 1–4.

Erect, branched herb, c. 3–14 cm high. Roots c. 0.2–0.3 mm in CS, with a few hairs. Stem c. 0.3–0.5 mm in CS, glabrous, internodes c. 3–21 mm long. *Leaves* oblong, acute, c. 1–2 (–2.5) by c. 0.5–0.9 mm, semi-amplexicaul, appressed or patent at c. 10°. *Raceme* c. 0.5–9.5 cm long, with c. 2–40 flowers, mostly all flowers to one side. Bracts oblong-lanceolate, acute, sessile, c. 1–1.5 (–2) by c. 0.3–0.5 mm, appressed to the pedicel. Pedicels c. 1–2 (–3) mm long and c. 0.1 (–0.25, liquid material) mm in CS, c. 60–90° patent, recurved. — ♂ *Flowers*: perianth segments 6, 3 larger alternating with 3 smaller ones, all reflexed and at the top bearded; larger segments oblong, acute, c. 0.5–0.8 by c. 0.3 mm; smaller segments oblong, acute, c. 0.4–0.6 by c. 0.25 mm. Stamens 3, c. 0.2–0.3 mm, filaments short and at the base connate, anthers 2-lobed. — ♀ *Flowers*: perianth like in the male flower but larger segments c. 1–1.2 by c. 0.5–0.6 mm, smaller segments c. 0.7–1 mm by c. 0.4 mm. *Carpels* c. 40–80, obovoid, c. 0.3–0.7 mm; style club-shaped, inserted laterally at the base or about halfway, when young mostly just exceeding the carpel; apex with many hairs and papillae.

Distr. *Malesia*: Borneo (Sarawak, W., E. & S. Kalimantan), New Guinea (NW. and NE. parts).

Ecol. Rain-forest, rooting between decaying leaves or in humus, in deep shade, 80–180 m.

Note. Fresh plant red.

**12. *Sciaphila consimilis*** BL. Mus. Bot. 1 (1851) 322; BTH. in Hook. J. Bot. Kew Misc. 7 (1855) 10; MIQ. Fl. Ind. Bat. 3 (1856) 232; F. v. M. in Walp. Ann. 5 (1860) 917; GIESEN, Pfl. R. Heft 104 (1938) 51, f. 10: 7–9.

Simple, erect but especially at the base a bit flexuous herb, c. 5.5–22 cm high. Roots c. 0.15–0.5 mm in CS, with hairs. Stem c. 0.2–0.5 mm in CS, gla-

brous, internodes c. 5–18 mm long. *Leaves* oblong-lanceolate, acute, c. 1–3 by c. 0.4–1.3 mm, semi-amplexicaul or not, appressed, the top mostly a bit patent. *Raceme* c. 2–14 cm long, flowers c. 15–70, all around. Bracts lanceolate, acute, c. 1–2 by c. 0.2–0.4 mm, sessile, mostly appressed to the pedicel, sometimes 10–30° patent. Pedicels c. 5–8 mm long and c. 0.1 mm in CS, 45–90° patent, recurved or often curled. — ♂ *Flowers*: perianth segments 6, 3 larger ones alternating with 3 smaller ones, all reflexed and at the top long-bearded; larger segments oblong-lanceolate, acute, c. 0.75–0.9 by c. 0.25–0.45 mm, smaller segments (oblong-)lanceolate, acute, c. 0.5–0.7 by c. 0.2–0.3 mm. Stamens 3, c. 0.25–0.3 mm; filaments short and at the base connate; anthers 3-lobed. — ♀ *Flowers*: perianth like in the male flower, but the top glabrous or with very few, short hairs and larger segments 0.7–1 by 0.3–0.45 mm, smaller segments 0.5–0.8 by 0.25–0.3 mm. *Carpels* c. 15–30, 0.2–0.25 mm; style club-shaped, inserted laterally at the base or about halfway, exceeding the carpel when young; apex with many hairs and papillae.

Distr. West Polynesia (Fiji Is.: Vanua Levu); in *Malesia*: Philippines (Luzon, Mindanao).

Ecol. In forest, amongst thick carpet of leaves.

Note. Stem curved whilst growing from under leaves to get to the light. Stems and fruits of fresh plant red.

**13. *Sciaphila multiflora*** GIESEN, Pfl. R. Heft 104 (1938) 49, f. 10: 1–2. — *S. macra* SCHLTR, Bot. Jahrb. 49 (1912) 86, f. 3: A–D, non K. SCH. & SCHLTR in K. Sch. & Laut. (1905), which is *S. secundiflora*. — *S. mindanaensis* GIESEN, Pfl. R. Heft 104 (1938) 51, f. 10: 3–6. — *S. stemmerrmannii* FOSB. & SACHET, Pac. Sci. 34 (1980) 15, f. 1–2.

Erect, sometimes a bit flexuous herb, 6–40 cm high, branched (mostly at the base). Roots c. 0.2–0.3 mm in CS, glabrous, seldom branched, sometimes with a few hairs. Stem c. 0.4–1.3 mm in CS, glabrous, or with a few hairs, internodes c. (5–) 12–50 mm long. *Leaves* oblong-ovate to oblong-lanceolate, acute, c. 1.5–3 by 0.8–1.2 mm, not amplexicaul, appressed. *Raceme* c. (2–) 7–31 cm long; flowers c. 8–40, all around or more or less to one side. Bracts oblong-lanceolate, acute, c. 1–2 by 0.4–0.8 mm, sessile, appressed to the pedicel but the top mostly a bit patent. Pedicels c. 2–4 mm long and c. 0.1–0.3 mm in CS, 45–90° patent, recurved. — ♂ *Flowers*: perianth segments 6, 3 larger ones alternating with 3 smaller ones, all reflexed and at the top bearded; larger segments oblong, acuminate, c. 0.8–1.3 by c. 0.3–0.5 mm, smaller ones oblong, acuminate, c. 0.6–1.1 by c. 0.3–0.4 mm. Stamens 3, c. 0.4 mm, filament short and at the base connate, anthers 3-lobed. — ♀ *Flowers*: perianth like in the male

flower but the apices glabrous or bearded, larger segments c. 0.9–1.5 by c. 0.3–0.8 mm, smaller segments c. 1.1–1.2 by c. 0.4–0.6 mm. *Carpels* c. 10–40, c. 0.2–0.35 mm; style club-shaped, inserted laterally at the base or about halfway, exceeding the carpel when young; apex with many hairs and papillae.

Distr. Micronesia (Carolines: Palau); in *Malesia*: New Guinea (E. part: Waria area; Milne Bay Distr.) and Philippines (Mindanao).

Ecol. Plant of primary forest, sometimes on steep slopes; 30–800 m. *Fl.* May, July.

Note. Fresh plant reddish purple, with tinged pink or purple flowers, anthers yellow; fruits dark-purple.

**14. *Sciaphila micranthera*** GIESEN, Pfl. R. Heft 104 (1938) 54, f. 12: 1–4.

Erect herb, c. 7–13 cm high, simple or branched at the base. Roots c. 0.15–0.2 mm in CS, with a few hairs. Stem c. 0.3–0.7 mm in CS, glabrous, internodes c. 5–10 mm long. *Leaves* oblong to lanceolate, acute, c. 1–3 by c. 0.4 mm, not amplexicaul, appressed or 20° patent. *Raceme* c. 2.5–11 cm long; flowers c. 15–90, more or less all around. Bracts lanceolate, acute to acuminate, c. 1–2 by c. 0.15–0.3 mm, more or less appressed to the pedicel. Pedicels c. (5–) 7–15 mm long and c. 0.15–0.2 mm in CS,

more or less perpendicular to the rachis, straight to slightly recurved, sometimes somewhat sinuous. — ♂ *Flowers*: perianth segments 6, 3 larger ones alternating with 3 smaller ones, all reflexed and at the apex bearded; the larger ones oblong-lanceolate, somewhat obtuse, c. 1 by 0.25 mm; the smaller ones oblong-lanceolate, obtuse, c. 0.8 by c. 0.2 mm. Stamens 3, c. 0.25–0.3 mm, almost sessile; filaments very short, anthers 4-celled, 4-lobed. — ♀ *Flowers*: perianth like in the male flowers; carpels c. 15–25, c. 0.3–0.35 mm; style inserted laterally about halfway, exceeding the carpel, club-shaped, the apex with hairs and papillae.

Distr. *Malesia*: Borneo (Sarawak and W. Kalimantan: Bt. Kenepai).

Ecol. Primary forest, growing on thick humus, 300 m.

Note. Fresh plant dark-red all over.

#### Doubtful

*Sciaphila papillosa* BECC. *Malesia* 3 (1890) 334, pl. 39: 1–4; GIESEN, Pfl. R. Heft 104 (1938) 67.

Based on a specimen of BECCARI from NW. New Guinea, Vogelkop Peninsula, Hatam, Mt Arfak in vii-1875 (FI?, *n.v.*). BECCARI has not seen any male flowers, so it is not possible to identify this species.













# FLORA MALESIANA

under the Auspices of Lembaga Biologi  
Nasional (Botanic Gardens of Indonesia), Bogor, Indonesia,  
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